Nokia Customer Care

Service Manual

RM-322; RM-323 (Nokia 6301)

Mobile Terminal

Part No: 9205161 (Issue 1)

COMPANY CONFIDENTIAL

NOKIA
Care

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Amendment Record Sheet

Amendment No	Date	Inserted By	Comments
Issue 1	11/2007	Y Liu	

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IMPORTANT

This document is intended for use by qualified service personnel only.

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Warnings and cautions

Warnings

- IF THE DEVICE CAN BE INSTALLED IN A VEHICLE, CARE MUST BE TAKEN ON INSTALLATION IN VEHICLES FITTED WITH ELECTRONIC ENGINE MANAGEMENT SYSTEMS AND ANTI-SKID BRAKING SYSTEMS. UNDER CERTAIN FAULT CONDITIONS, EMITTED RF ENERGY CAN AFFECT THEIR OPERATION. IF NECESSARY, CONSULT THE VEHICLE DEALER/ MANUFACTURER TO DETERMINE THE IMMUNITY OF VEHICLE ELECTRONIC SYSTEMS TO RF ENERGY.
- THE PRODUCT MUST NOT BE OPERATED IN AREAS LIKELY TO CONTAIN POTENTIALLY EXPLOSIVE ATMOSPHERES, FOR EXAMPLE, PETROL STATIONS (SERVICE STATIONS), BLASTING AREAS ETC.
- OPERATION OF ANY RADIO TRANSMITTING EQUIPMENT, INCLUDING CELLULAR TELEPHONES, MAY INTERFERE WITH THE FUNCTIONALITY OF INADEQUATELY PROTECTED MEDICAL DEVICES. CONSULT A PHYSICIAN OR THE MANUFACTURER OF THE MEDICAL DEVICE IF YOU HAVE ANY QUESTIONS. OTHER ELECTRONIC EQUIPMENT MAY ALSO BE SUBJECT TO INTERFERENCE.
- BEFORE MAKING ANY TEST CONNECTIONS, MAKE SURE YOU HAVE SWITCHED OFF ALL EQUIPMENT.

Cautions

- Servicing and alignment must be undertaken by qualified personnel only.
- Ensure all work is carried out at an anti-static workstation and that an anti-static wrist strap is worn.
- Ensure solder, wire, or foreign matter does not enter the telephone as damage may result.
- Use only approved components as specified in the parts list.
- Ensure all components, modules, screws and insulators are correctly re-fitted after servicing and alignment.
- Ensure all cables and wires are repositioned correctly.
- During testing never activate the GSM transmitter without a proper antenna load, otherwise the GSM PA may be damaged.

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For your safety

QUALIFIED SERVICE

Only qualified personnel may install or repair phone equipment.

ACCESSORIES AND BATTERIES

Use only approved accessories and batteries. Do not connect incompatible products.

CONNECTING TO OTHER DEVICES

When connecting to any other device, read its user's guide for detailed safety instructions. Do not connect incompatible products.

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Care and maintenance

This product is of superior design and craftsmanship and should be treated with care. The suggestions below will help you to fulfil any warranty obligations and to enjoy this product for many years.

- Keep the phone and all its parts and accessories out of the reach of small children.
- Keep the phone dry. Precipitation, humidity and all types of liquids or moisture can contain minerals that will corrode electronic circuits.
- Do not use or store the phone in dusty, dirty areas. Its moving parts can be damaged.
- Do not store the phone in hot areas. High temperatures can shorten the life of electronic devices, damage batteries, and warp or melt certain plastics.
- Do not store the phone in cold areas. When it warms up (to its normal temperature), moisture can form inside, which may damage electronic circuit boards.
- Do not drop, knock or shake the phone. Rough handling can break internal circuit boards.
- Do not use harsh chemicals, cleaning solvents, or strong detergents to clean the phone.
- Do not paint the phone. Paint can clog the moving parts and prevent proper operation.
- Use only the supplied or an approved replacement antenna. Unauthorised antennas, modifications or attachments could damage the phone and may violate regulations governing radio devices.

All of the above suggestions apply equally to the product, battery, charger or any accessory.

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ESD protection

Nokia requires that service points have sufficient ESD protection (against static electricity) when servicing the phone.

Any product of which the covers are removed must be handled with ESD protection. The SIM card can be replaced without ESD protection if the product is otherwise ready for use.

To replace the covers ESD protection must be applied.

All electronic parts of the product are susceptible to ESD. Resistors, too, can be damaged by static electricity discharge.

All ESD sensitive parts must be packed in metallized protective bags during shipping and handling outside any ESD Protected Area (EPA).

Every repair action involving opening the product or handling the product components must be done under ESD protection.

ESD protected spare part packages MUST NOT be opened/closed out of an ESD Protected Area.

For more information and local requirements about ESD protection and ESD Protected Area, contact your local Nokia After Market Services representative.

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Battery information

Note: A new battery's full performance is achieved only after two or three complete charge and discharge cycles!

The battery can be charged and discharged hundreds of times but it will eventually wear out. When the operating time (talk-time and standby time) is noticeably shorter than normal, it is time to buy a new battery.

Use only batteries approved by the phone manufacturer and recharge the battery only with the chargers approved by the manufacturer. Unplug the charger when not in use. Do not leave the battery connected to a charger for longer than a week, since overcharging may shorten its lifetime. If left unused a fully charged battery will discharge itself over time.

Temperature extremes can affect the ability of your battery to charge.

For good operation times with Ni-Cd/NiMh batteries, discharge the battery from time to time by leaving the product switched on until it turns itself off (or by using the battery discharge facility of any approved accessory available for the product). Do not attempt to discharge the battery by any other means.

Use the battery only for its intended purpose.

Never use any charger or battery which is damaged.

Do not short-circuit the battery. Accidental short-circuiting can occur when a metallic object (coin, clip or pen) causes direct connection of the + and - terminals of the battery (metal strips on the battery) for example when you carry a spare battery in your pocket or purse. Short-circuiting the terminals may damage the battery or the connecting object.

Leaving the battery in hot or cold places, such as in a closed car in summer or winter conditions, will reduce the capacity and lifetime of the battery. Always try to keep the battery between 15°C and 25°C (59°F and 77°F). A phone with a hot or cold battery may temporarily not work, even when the battery is fully charged. Batteries' performance is particularly limited in temperatures well below freezing.

Do not dispose of batteries in a fire!

Dispose of batteries according to local regulations (e.g. recycling). Do not dispose as household waste.

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Company Policy

Our policy is of continuous development; details of all technical modifications will be included with service bulletins.

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Nokia 6301 Service Manual Structure

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2 Service Tools and Service Concepts
3 BB Troubleshooting and Manual Tuning Guide
4 RF Troubleshooting and Manual Tuning Guide
5 System module
Glossary

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1 — General information

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Product selection

The RM-322/323 is (max 2W) GSM triband hand portable phone, supporting GSM 850/1800/1900 (RM-323) and 900/1800/1900 (RM-322) bands, respectively. The RM-322/323 also supports EGPRS and GPRS (Packed data). Moreover, The RM-322/323 supports WLAN 802.11 b/g 2.4 Ghz for UMA (Unlicensed Mobile Access), with automatic switching between WLAN and cellular networks. It is class B&C terminals, supporting EGPRS multislot class 10 (4Rx + 1Tx and 3Rx + 2Tx) and GPRS multislot class 10 (4+1, 3+2).

The RM-322/323 is MMS (Multimedia Messaging Services) version 1.2 enabled phone with a QVGA 240x320 pixel, active TFT 16.7 million colour display. It also has an integrated 2 Mpix digital camera with a 8 x digtal zoom.

The RM-322/323 has a 3GPP video player/recorder, FM stereo radio and a music player, and it supports Bluetooth 2.0 + EDR standard as well as microSD card.

The XHTML/WAP browser in RM-322/323 is compatible with the version 2.0 specifications and it supports HTTP/TCP/IP stack.

In addition the RM-322/323 is Java-enabled phone (Java™ 2 Platform, Micro Edition, for embedded devices). It supports MIDP Java 2.0 with additionally APIs.

The supported user interface is S40, that is, RM-322/323 software is based on the ISA platform.

Figure 1 The product picture of RM-322/323

Phone features

General features

- Demo mode (phone demo without SIM card)

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Hardware features

Display and keypad features

- Main display: Active TFT QVGA display supporting up to 16,7 million colors (320 x 240 pixels, 2 inches active area)
- Power switch
- Side volume keys

Hardware characteristics

- Monoblock phone
- 2-Mpix camera with 8 x digital zoom
- Hotswap µSD memory card slot (under the battery cover)
- Stereo FM radio and music player
- Integrated handsfree speaker
- Internal vibra
- Bluetooth
- 2.0 mm DC charger plug interface
- Mini-USB connector
- 2.5mm Nokia AV connector
- WLAN 802.11 b/g

Software and User interface features

Software features

- ISA OS 8.0s Platform
- Nokia Series 40 User interface (UI): Java™ MIDP 2.0

UI features

Imaging	• 2.0-megapixel camera with 8x digital zoom (1600 x 1200 pixel resolution) • Full-screen viewfinder • PictBridge printing via USB cable
Multimedia	• MP3 player supporting formats including MP3, Midi, AAC, AAC+, enhanced AAC+, WMA • FM stereo radio, Visual Radio and music player • 3GPP video player/recorder • MP3 ringing tones, True tones and MIDI tones, with support of 64 polyphony
Memory functions	• Combo memory with 64 MB flash and 32 MB RAM – about 30 MB user memory (for gallery and applications, contacts, notes, calendar entries) • Hotswap microSD memory card slot supporting up to 2GB microSD memory cards (available as enhancements)

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Messaging	• Simplified messaging with recently used contacts log and groups • Email: Access your work and private email accounts; supports SMTP, POP3, and IMAP4 protocols. Support for attachments (Java version) • Audio messaging service (AMS): Record your own voice message and send to compatible devices • MMS OMA 1.2: Combine image, video, text, and voice clips and send as an MMS to a compatible phone or PC; use MMS to tell your story with a multi-slide presentation. The MMS OMA 1.2 specification allows you to send/ receive messages up to 300 kB in size. • Text messaging: Supports concatenated SMS, picture messaging, SMS distribution list • Predictive text input: Support for all major languages in Europe and Asia-Pacific • Instant Messaging (IM)
Applications	• Java™ MIDP 2.0 with over-the-air download • Pre-installed Java™-based applications and games • SIM Application Toolkit • Wireless Presenter
Connectivity	• WLAN 802.11 b/g 2.4 Ghz for UMA, with automatic switching between WLAN and cellular networks • Nokia PC Suite with USB and Bluetooth connectivity • Bluetooth wireless connectivity (SIM access, headset, and handsfree profiles) incl. stereo support for headsets • Nokia AV connector interface with USB • FOTA (Flashing over-the-air) • Local/remote SyncML data synchronization
Browsing	• Integrated XHTML browser • Smart content download - OMA DRM 2.0
Data transfer	• EDGE (EGPRS): Class 10, download up to 236.8 kbps • GPRS: Class 10, download up to 53.6 kbps **Note:** Actual achieved speeds may vary depending on network support • GPRS/EDGE/HSCSD/CSD for browsing and as data modem • Downlink Advanced Receiver Performance (DARP)
Voice features	• Push To Talk: Select the person or group you want to talk to and press the Push To Talk key to communicate • Enhanced voice dialling with SIND: Speaker-independent name dialling for easy call handling • Integrated handsfree speaker with a new high quality speaker for better audio experience (stereo widening effects when attaching the headset) • Voice commands • Voice recorder

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Digital services	• User Interface (UI) themes including e.g. animated wallpapers, screensavers, color schemes, ringing tones • Ringing tones: Video, MP3 ringing tones, True Tones and MIDI ringing, alert, and gaming tones with support of 64 polyphony • OTA download possibility for: Themes, True Tones, MP3 ringing tones, MIDI ringing tones, screensavers, wallpapers, 3GPP streaming, images and videos, Series 40 Java games and applications
Personal information management (PIM)	• Organizer with alarm clock, calendar, to-do list, notes, calculator, countdown timer, and stopwatch • Manage your time and information with the enhanced calendar that can be synchronized, for example, with Microsoft and Lotus PIM application calendars by using the Nokia PC Suite
Call management	• Speed dialling • Logs: Keeps lists of your dialled, received, and missed calls • Automatic answer (works with headset or car kit only) • Call waiting, call hold, call divert, call timer

Accessories

Table 1 Audio

Type	Name
AD-42W	Wireless audio gateway
HS-40	Mono headset
HS-16, HS-42, HS-47	Stereo headsets
HS-24W, HS-26W,HS-57 W	Wireless stereo headsets

Table 2 Battery and chargers

Type	Name
Note: This phone is charged through the smaller Nokia standard interface (2.0 mm plug). The 3.5 mm standard charger can be used together with the CA-44 charger adapter.	
AC-3/AC-5	Compact charger
AC-4	Travel charger
BL-4C	Battery 860 mAh Li-Ion
CA-44	Charger adapter (from 3.5 mm -> 2 mm)

Table 3 Car accessories

Type	Name
CK-1W	Wireless car kit

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Type	Name
CK-7W	Basic universal car kit
CK-20W	Car Installation Kit
CR-39	Universal holder
DC-4	Mobile charger
HF-35W	Wireless Car Handsfree
N616	Car phone

Table 4 Data

Type	Name
DKE-2	Mini USB connectivity cable
MU-22	1 GB µSD card
MU-26	128 MB µSD card
MU-27	256 MB µSD card
MU-28	512 MB µSD card
MU-37	2 GB µSD card

Table 5 Imaging

Type	Name
PT-6	Remote camera

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2 — Service Tools and Service Concepts

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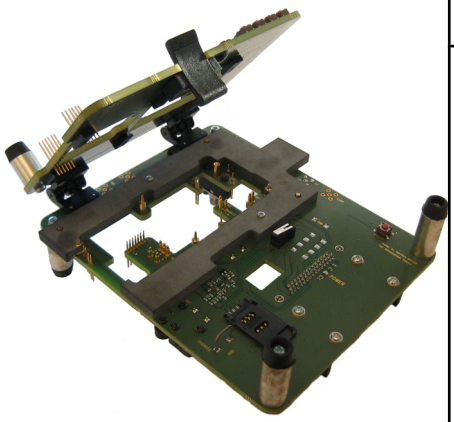
Service tools

Product specific tools

The table below gives a short overview of service tools that can be used for testing, error analysis and repair of product RM-322; RM-323, refer to various concepts.

FS-47	Flash adapter	
For flashing (also dead phones) with SS-64. RF testing and tuning, and EM calibration on ATO level with SS-62 (mechanical locking concept), CU-4 supported.		



MJ-156	Module jig	

MJ-156 is meant for troubleshooting, testing, tuning and flashing on the engine level (CU-4 supported).

The jig includes an RF interface for GSM and Bluetooth.

The following table shows the attenuation values for galvanic RF connetion:

Band	Tuning channel	Attenuation RX	Attenuation TX
GSM850	190	0.1	0.1
GSM900	37	0.1	0.1
GSM1800	700	0.15	0.15
GSM1900	661	0.15	0.15
WLAN	2437 MHz	0.2	0.2

RJ-148	Soldering jig	
RJ-148 is a soldering jig used for soldering and as a rework jig for the engine module.		

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SA-123	RF coupler	

SA-123 is an RF coupler for GSM RF testing. It is used together with the product-specific flash adapter.

The following table shows attenuations from the antenna pads of the mobile terminal to the SMA connectors of SA-123:

- **RM-322**

Band	Channel	Tx-att. (dB)	Rx-att. (dB)
EGSM 900	975	5.6	6
	38	5.2	7
	124	5.2	7
GSM 1800	512	7.3	10
	698	8.2	10
	885	8.1	10
GSM 1900	512	8.6	9
	661	8.7	7
	810	9.1	7

Tx-attenuation tolerance is +/-0.5 dB

Rx-attenuation tolerance is +/-1.0dB

- **RM-323**

Band	Channel	Tx-att. (dB)	Rx-att. (dB)
GSM 850	128	8.1	9
	190	7.4	9
	251	7.7	10
GSM 1800	512	8.6	7
	698	8.7	8
	885	7.5	6
GSM 1900	512	6.7	8
	661	6.1	8
	810	6.8	8

Tx-attenuation tolerance is +/-0.5 dB

Rx-attenuation tolerance is +/-1.0dB

General tools

The table below gives a short overview of service tools that can be used for testing, error analysis and repair of product RM-322; RM-323, refer to various concepts.

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CU-4	Control unit	

CU-4 is a general service tool used with a module jig and/or a flash adapter. It requires an external 12 V power supply.

The unit has the following features:

- software controlled via USB
- EM calibration function
- Forwards FBUS/Flashbus traffic to/from terminal
- Forwards USB traffic to/from terminal
- software controlled BSI values
- regulated VBATT voltage
- 2 x USB2.0 connector (Hub)
- FBUS and USB connections supported

When using CU-4, note the special order of connecting cables and other service equipment:

Instructions

1 Connect a service tool (jig, flash adapter) to CU-4.
2 Connect CU-4 to your PC with a USB cable.
3 Connect supply voltage (12 V)
4 Connect an FBUS cable (if necessary).
5 Start Phoenix service software.

Note: Phoenix enables CU-4 regulators via USB when it is started.

Reconnecting the power supply requires a Phoenix restart.

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FLS-4S	Flash device	
FLS-4S is a dongle and flash device incorporated into one package, developed specifically for POS use.		

FLS-5	Flash device	
FLS-5 is a dongle and flash device incorporated into one package, developed specifically for POS use. **Note:** FLS-5 can be used as an alternative to PKD-1.		

FPS-10	Flash prommer	
FPS-10 interfaces with: • PC • Control unit • Flash adapter • Smart card FPS-10 flash prommer features: • Flash functionality for BB5 and DCT-4 terminals • Smart Card reader for SX-2 or SX-4 • USB traffic forwarding • USB to FBUS/Flashbus conversion • LAN to FBUS/Flashbus and USB conversion • Vusb output switchable by PC command FPS-10 sales package includes: • FPS-10 prommer • Power Supply with 5 country specific cords • USB cable **Note:** FPS-21 is substitute FPS-10 if FPS-10 has not been set up.		

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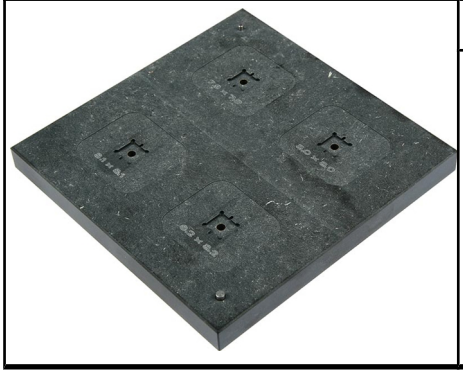
	JBT-9	Bluetooth test and interface box (sales package)	
	The JBT-9 test box is a generic service device used to perform Bluetooth bit error rate (BER) testing, and establishing cordless FBUS connection via Bluetooth. An ACP-8x charger is needed for BER testing and an AXS-4 cable in case of cordless interface usage testing . Sales package includes: • JBT-9 test box • Installation and warranty information		
	PK-1	Software protection key	
	PK-1 is a hardware protection key with a USB interface. It has the same functionality as the PKD-1 series dongle. PK-1 is meant for use with a PC that does not have a series interface. To use this USB dongle for security service functions please register the dongle in the same way as the PKD-1 series dongle.		
	PKD-1	SW security device	
	SW security device is a piece of hardware enabling the use of the service software when connected to the parallel (LPT) port of the PC. Without the device, it is not possible to use the service software. Printer or any such device can be connected to the PC through the device if needed.		
	RJ-209	Rework jig	
	RJ-209 is used as a rework jig for the WLAN 4.0 module This stencil takes the WLAN 4.0 module for spreading soldering paste onto the component. This must be used together with the ST-64 rework stencil.		
	RJ-93	Rework jig	
	RJ-93 is used as a rework jig for the engine module. This stencil takes the front end module (FEM) or power amplifier (PA) module for spreading the soldering paste to the component. Must be used together with the ST-40 stencil.		

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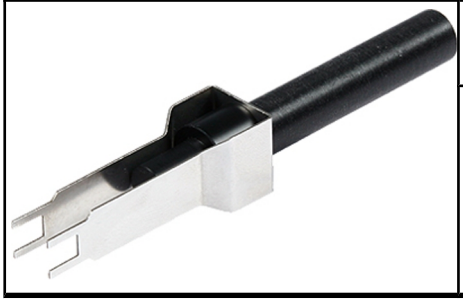
	SB-7	WLAN test box	
	WLAN test requires defined position for the device.		
	SPS-1	Soldering Paste Spreader	
	The SPS-1 allows spreading of solder to the LGA components pads over the rework stencils.		
	SRT-6	Opening tool	
	SRT-6 is used to open phone covers.		
	SS-45	Front camera removal tool	
	The front camera removal tool SS-45 is used to remove/attach the front camera module from/to the socket.		

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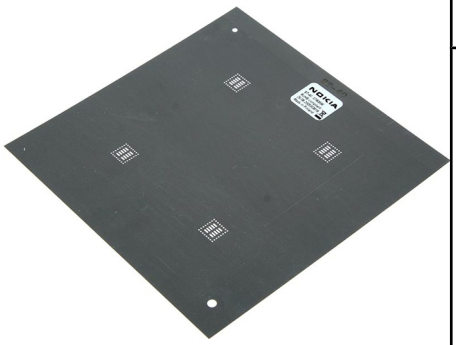
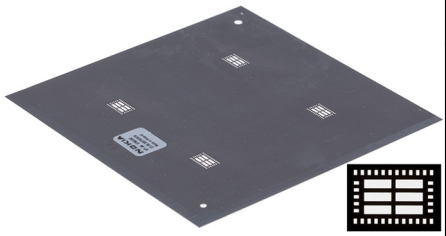
	SS-46	Interface adapter	
	SS-46 acts as an interface adapter between the flash adapter and FPS-10.		
	SS-62	Generic flash adapter base for BB5	
	• generic base for flash adapters and couplers • SS-62 equipped with a clip interlock system • provides standardised interface towards Control Unit • provides RF connection using galvanic connector or coupler • multiplexing between USB and FBUS media, controlled by VUSB		
	ST-40	Rework stencil	
	ST-40 is a rework stencil and used with RJ-93.		
	ST-64	Rework stencil	
	ST-64 is the stencil used during rework of the WLAN 4.0 module. It must be used together with the RJ-209 rework jig.		
	SX-4	Smart card	
	SX-4 is a BB5 security device used to protect critical features in tuning and testing. SX-4 is also needed together with FPS-10 when DCT-4 phones are flashed.		

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Cables

The table below gives a short overview of service tools that can be used for testing, error analysis and repair of product RM-322; RM-323, refer to various concepts.

	CA-31D	USB cable	
	The CA-31D USB cable is used to connect FPS-10 or FPS-11 to a PC. It is included in the FPS-10 and FPS-11 sales packages.		
	CA-35S	Power cable	
	CA-35S is a power cable for connecting, for example, the FPS-10 flash prommer to the Point-Of-Sales (POS) flash adapter.		
	DAU-9S	MBUS cable	
	The MBUS cable DAU-9S has a modular connector and is used, for example, between the PC's serial port and module jigs, flash adapters or docking station adapters. **Note:** Docking station adapters valid for DCT4 products.		

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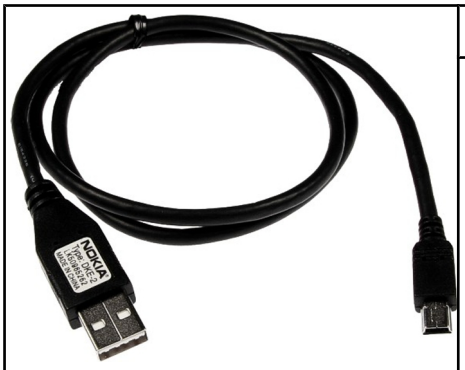
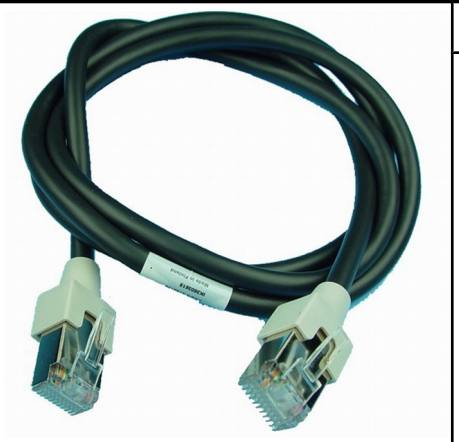
	DKE-2	Mini-USB cable	
	USB to mini-USB connector cable.		
	PCS-1	Power cable	
	The PCS-1 power cable (DC) is used with a docking station, a module jig or a control unit to supply a controlled voltage.		
	XCS-4	Modular cable	
	XCS-4 is a shielded (one specially shielded conductor) modular cable for flashing and service purposes.		
	XRE-2	Bluetooth cable	
	The bluetooth cable connects the bluetooth connector of the module jig to the bluetooth test box JBT-9.		

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XRS-6	RF cable	

The RF cable is used to connect, for example, a module repair jig to the RF measurement equipment.

SMA to N-Connector approximately 610 mm.

Attenuation for:

- GSM850/900: 0.3+-0.1 dB
- GSM1800/1900: 0.5+-0.1 dB
- WLAN: 0.6+-0.1dB

Service concepts

POS (Point of Sale) flash concept

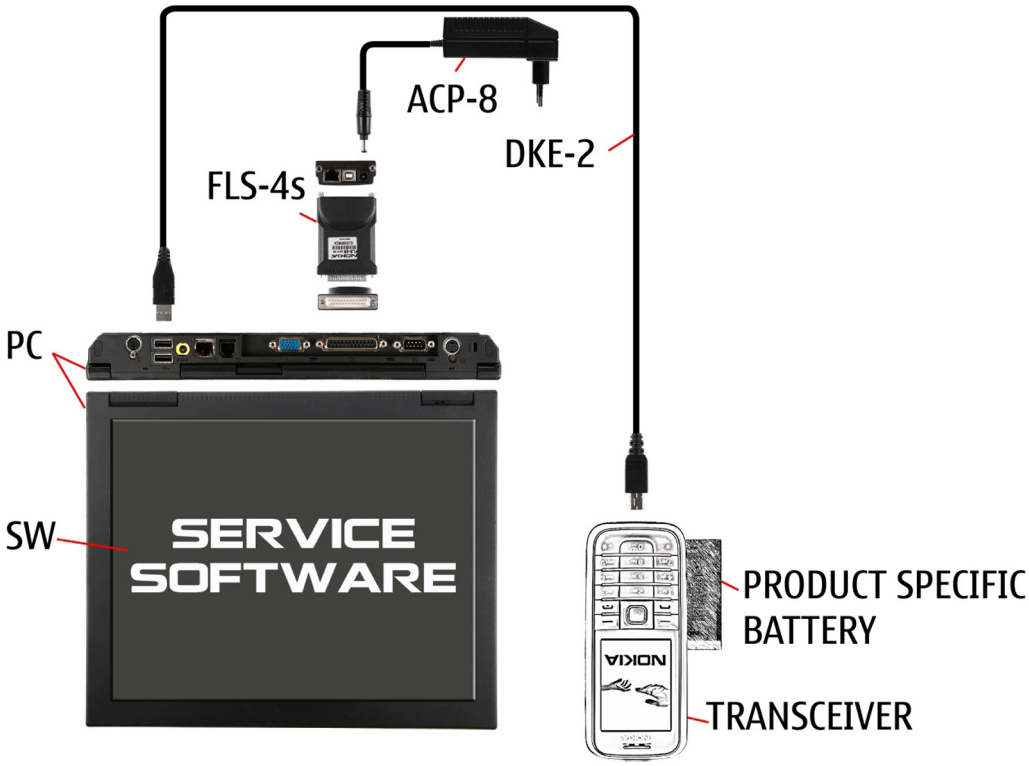

Figure 2 POS flash concept

Type	Description
Product specific devices	
BL-4C	Battery
Other devices	
ACP-8	Power adapter
FLS-4S or FLS-5	POS flash dongle

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Type	Description
	PC with Phoenix service software
Cables	
DKE-2	USB connectivity cable

Flash concept with FPS-10

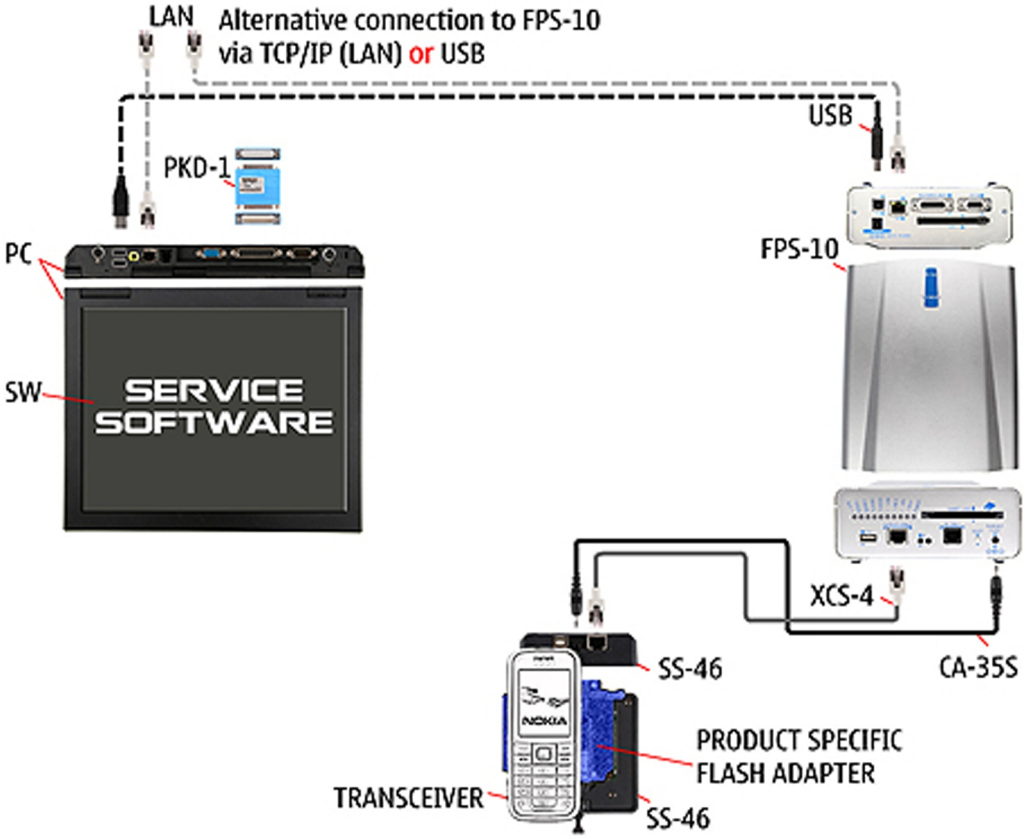

Figure 3 Basic flash concept with FPS-10

Type	Description
Product specific devices	
FS-47	Flash adapter
Other devices	
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SS-46	Interface adapter
	PC with Phoenix service software
Cables	
XCS-4	Modular cable
CA-35S	Power cable

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Type	Description
	USB cable

CU-4 flash concept with FPS-10

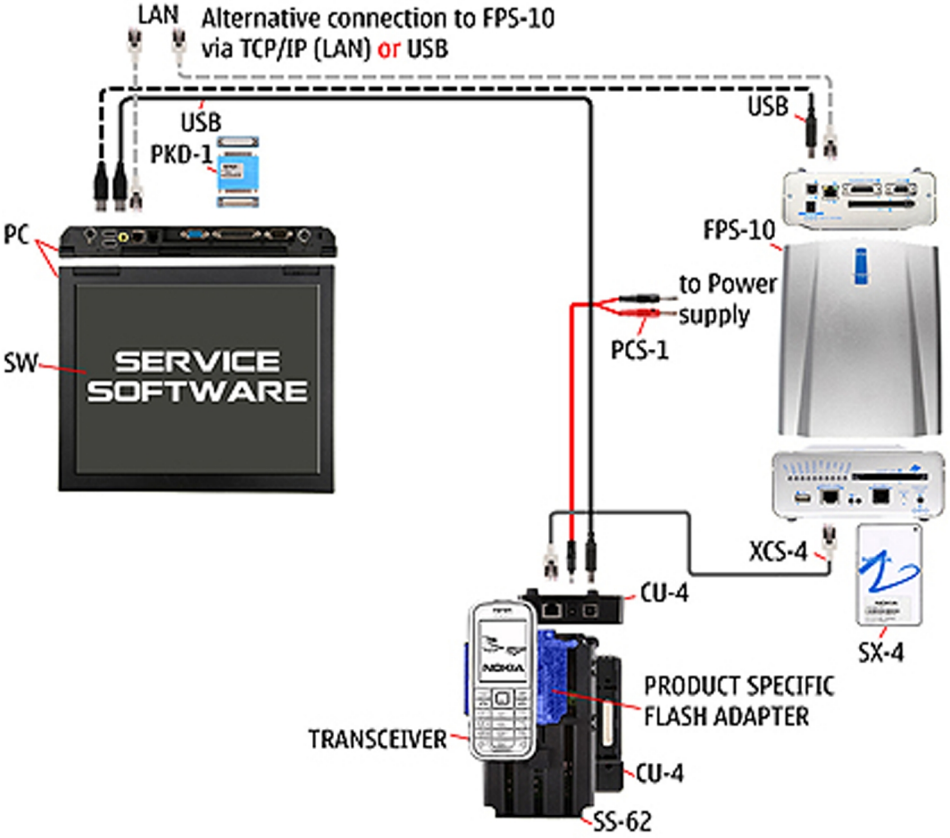

Figure 4 CU-4 flash concept with FPS-10

Type	Description
Product specific devices	
FS-47	Flash adapter
Other devices	
CU-4	Control unit
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SS-62	Flash adapter base
SX-4	Smart card
	PC with Phoenix service software
Cables	
PCS-1	Power cable
XCS-4	Modular cable
	Standard USB cable

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Type	Description
	USB cable

Module jig service concept

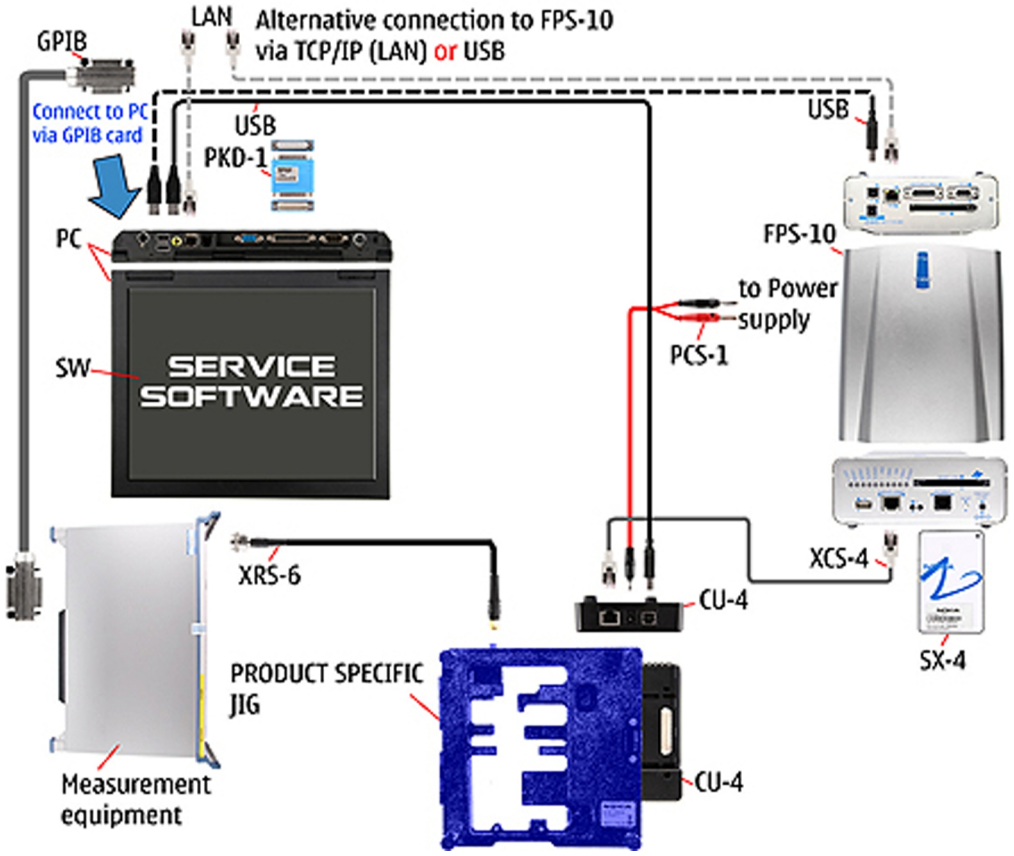

Figure 5 Module jig service concept

Type	Description
Phone specific devices	
MJ-156	Module jig
Other devices	
CU-4	Control unit
FPS-10	Flash prommer box
PK-1	SW security device
SX-4	Smart card
	PC with VPOS and Phoenix service software
	Measurement equipment
Cables	
PCS-1	DC power cable
XCS-4	Modular cable

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Type	Description
XRF-1	RF cable
	USB cable
	GPIB control cable

RF testing concept with RF coupler

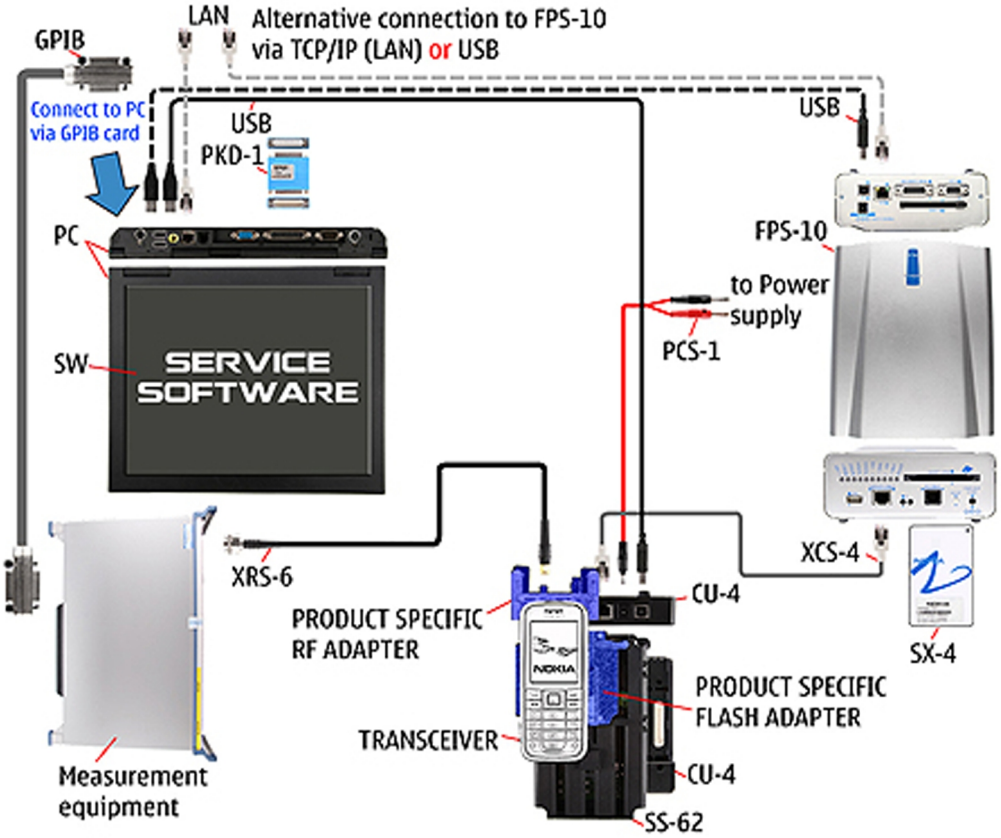

Figure 6 RF testing concept with RF coupler

Type	Description
Product specific devices	
FS-47	Flash adapter
SA-123	RF coupler
Other devices	
CU-4	Control unit
SX-4	Smart card
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SS-62	Flash adapter base
	Measurement equipment
	PC with Phoenix service software

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Type	Description
Cables	
PCS-1	Power cable
XCS-4	Modular cable
XRS-6	RF cable
	GPIB control cable
	USB cable

Service concept for RF testing and RF/BB tuning

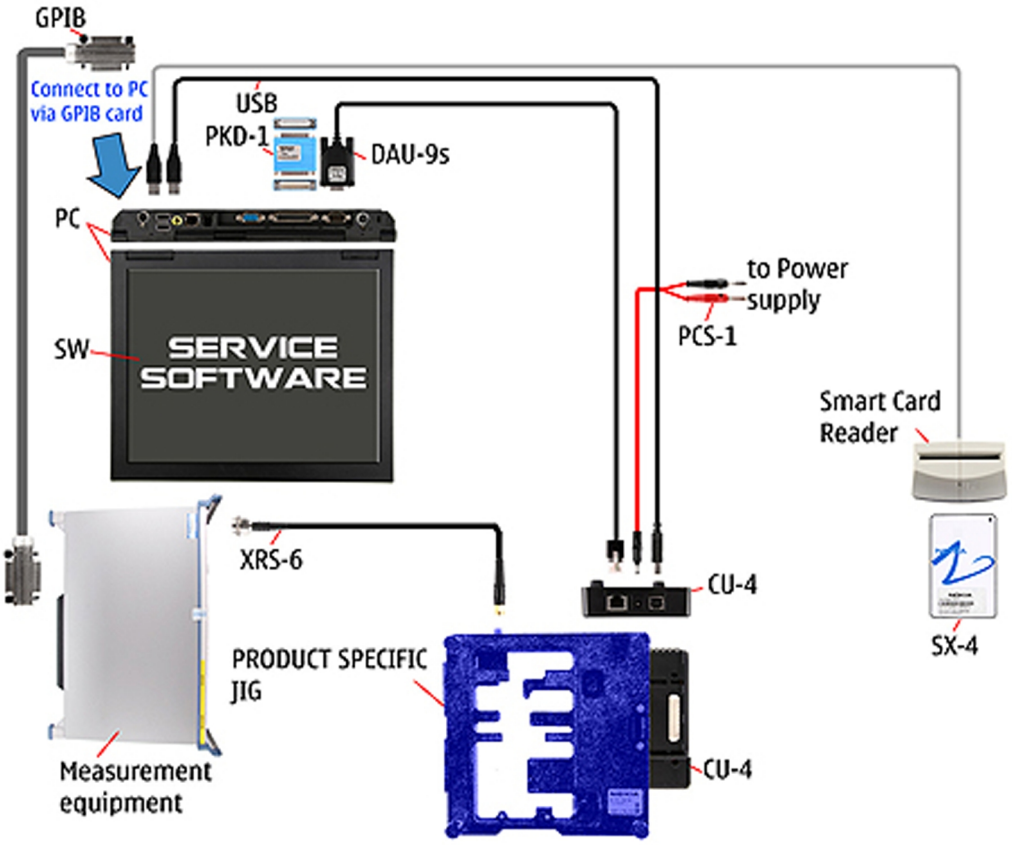

Figure 7 Service concept for RF testing and RF/BB tuning

Type	Description
Product specific devices	
MJ-156	Module jig
Other devices	
CU-4	Control unit
PK-1	SW security device
SX-4	Smart card
	Measurement equipment

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Type	Description
	Smart card reader
	PC with Phoenix service software
Cables	
DAU-9S	MBUS cable
PCS-1	DC power cable
XRS-6	RF cable
	GPIB control cable
	USB cable

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3 — BB Troubleshooting and Manual Tuning Guide

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Baseband troubleshooting overview

This section is intended to be a guide for localising and repairing electrical faults.

The table below tells you what troubleshooting to go to.

Problem	Troubleshooting
Abnormal current consumption	1 General power checking (page 3–6) 2 Battery current measuring fault (page 3–6)
Flashing does not work or the problem is not clearly defined	1 Flashing (page 3–15) 2 Clocking (page 3–9) 3 Combo memory (page 3–14)
Charging does not work	Charging (page 3–8)
Display does not work	Display fault (page)
Backlights do not work	1 Backlight (page 3–22) 2 LED driver (page 3–8)
Reminder LEDs do not work	Reminder LED (page 3–23)
USB does not work	USB (page 3–36)
Audio (mic, earpiece, IHF) does not work	1 Audio (page 3–25) 2 Acoustics (page 3–25)
Camera does not work	1 Camera baseband hardware (page 3–11) 2 Camera viewfinder (page 3–12) 3 Bad image quality (page 3–13)
Bluetooth does not work	Bluetooth (BT) (page)
FM radio does not work	FM radio (page)
MicroSD card does not work	MicroSD card (page)

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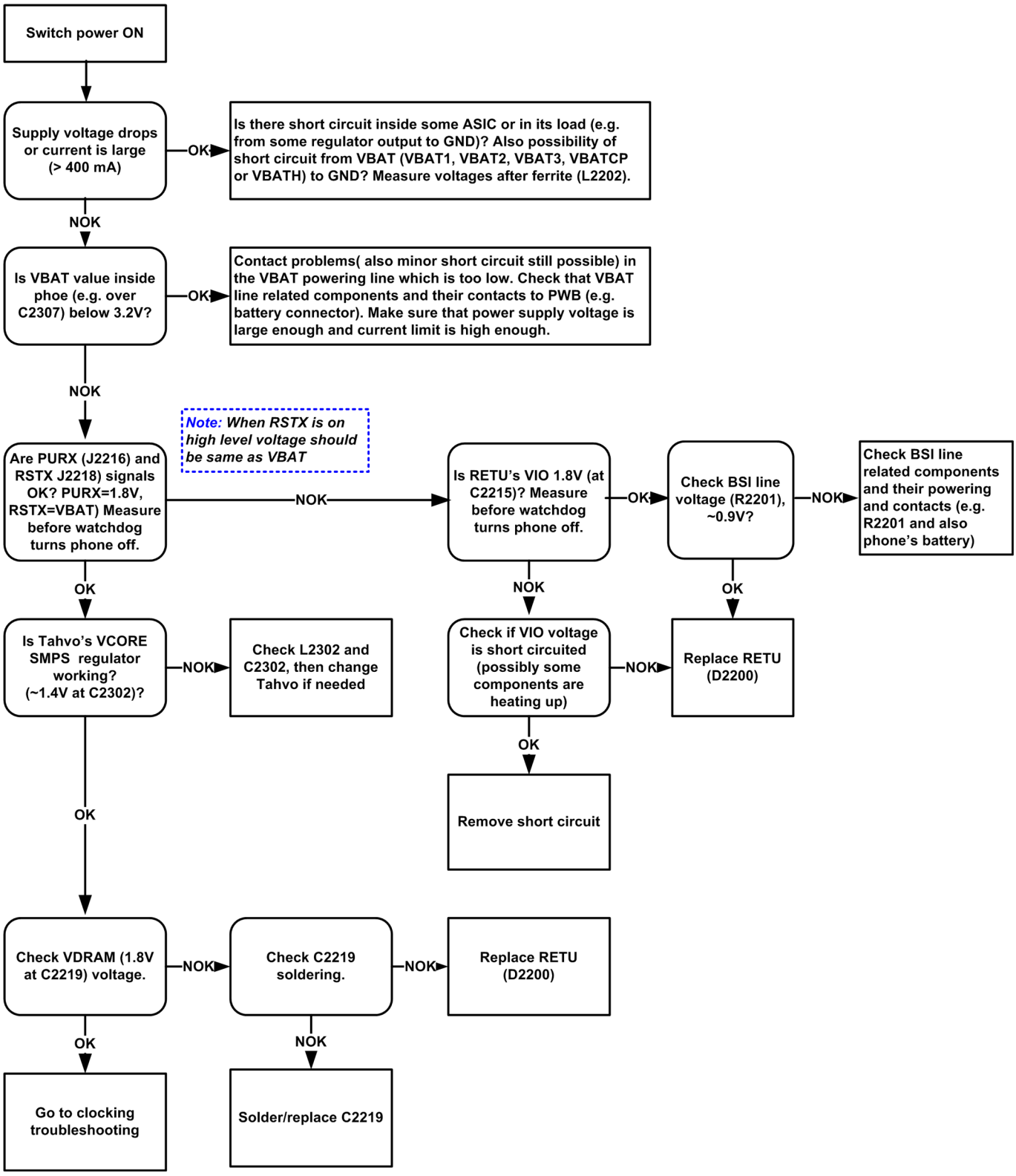
Power and charging troubleshooting

General power checking troubleshooting

Troubleshooting flow



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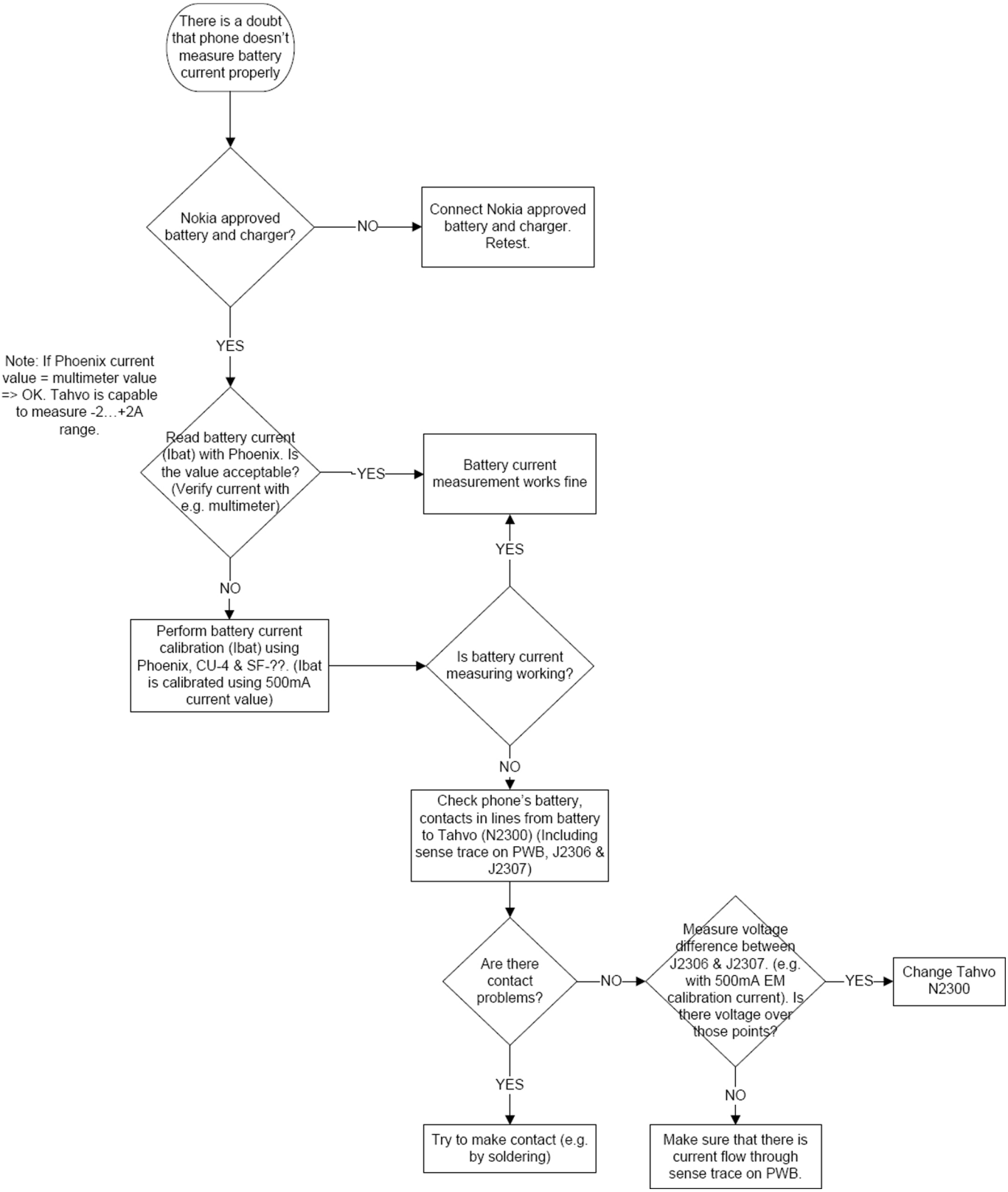
Battery current measuring fault troubleshooting

Troubleshooting flow



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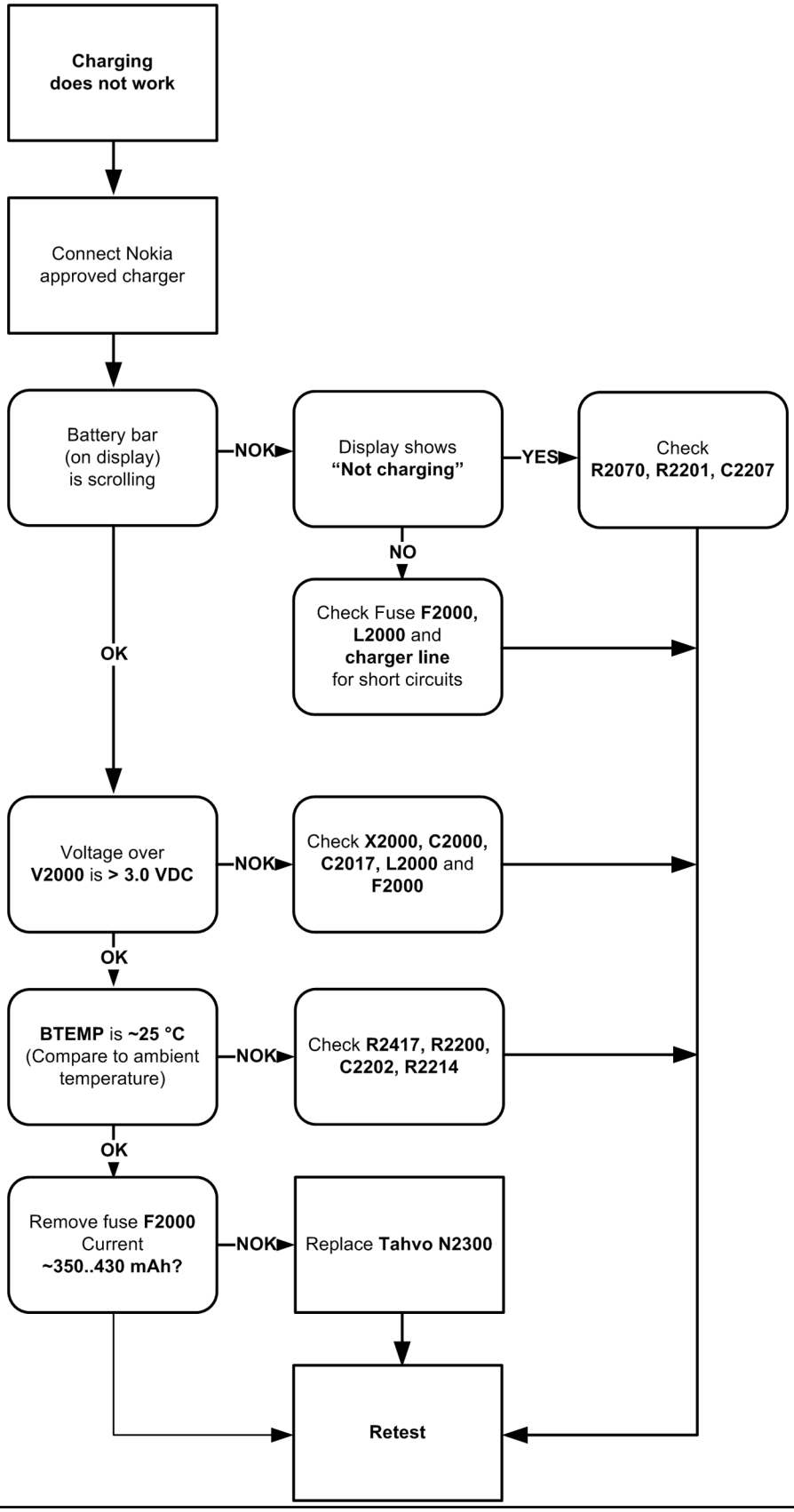
Charging troubleshooting

Troubleshooting flow



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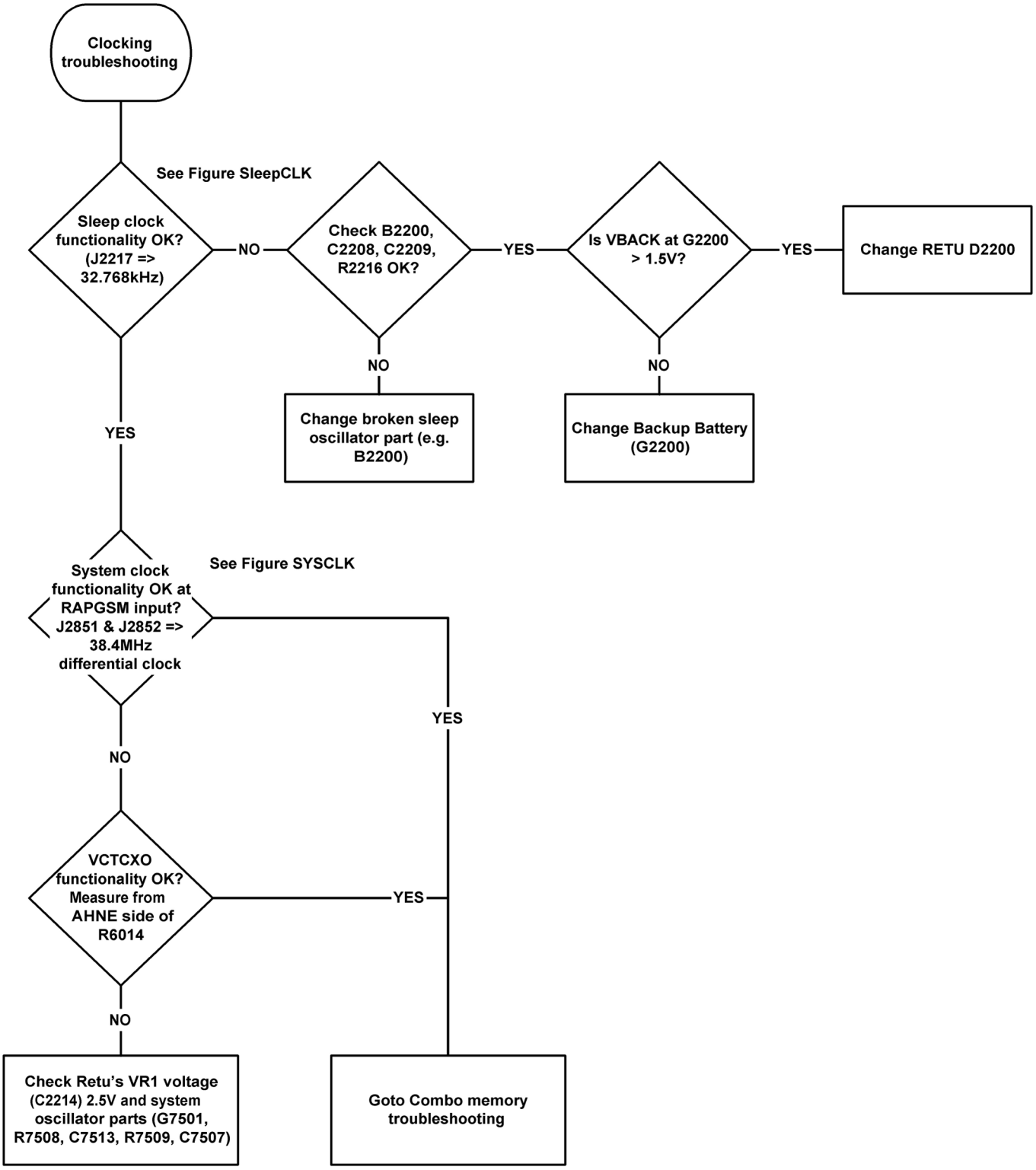
Clocking troubleshooting

Troubleshooting flow



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Interface troubleshooting

Camera failure

Introduction to camera troubleshooting

Bad conditions often cause bad pictures. Therefore, the camera operation has to be checked in constant conditions or by using a second, known-to-be-good Nokia device as reference. Image quality is hard to measure quantitatively, and the difference between a good and a bad picture can be small. Some training or experience may be needed to detect what is actually wrong.

When checking for possible errors in camera functionality, knowing what error is suspected significantly helps the testing by narrowing down the amount of test cases. The following types of image quality problems are common:

- Dust (black spots)
- Lack of sharpness
- Bit errors

Taking and evaluating test pictures

When *taking* a test picture, remember the following:

- Avoid bright fluorescent light, 50/60Hz electrical network or high artificial illumination levels
- If the phone is hot, let it rest for a while before taking the picture
- Make sure the optical system is clean
- Use highest possible resolution
- Make sure the light is suffiecient (bright office lightning)
- Do not take the picture towards light source
- Be as still as possible when taking the picture
- Distance should be at least 40cm, 1-2m is recommended

When *evaluating* a test picture, remember the following:

- The center of the picture is sharper than the edges
- The image may be blurred, though it does not show in the viewfinder
- Analyse the picture from your PC monitor, full colour setting is recommended
- If possible, compare with a picture of the same motive taken with a similar Nokia device

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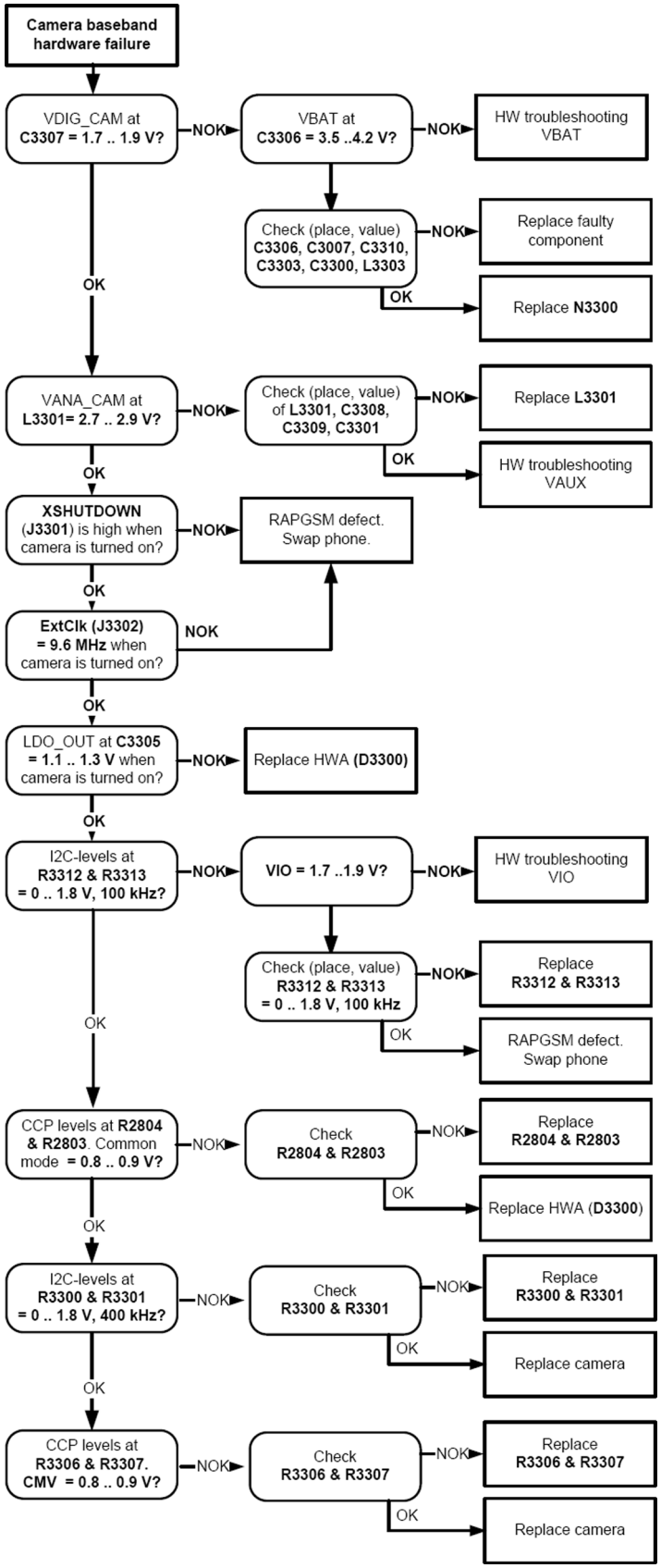
Camera hardware troubleshooting

Troubleshooting flow



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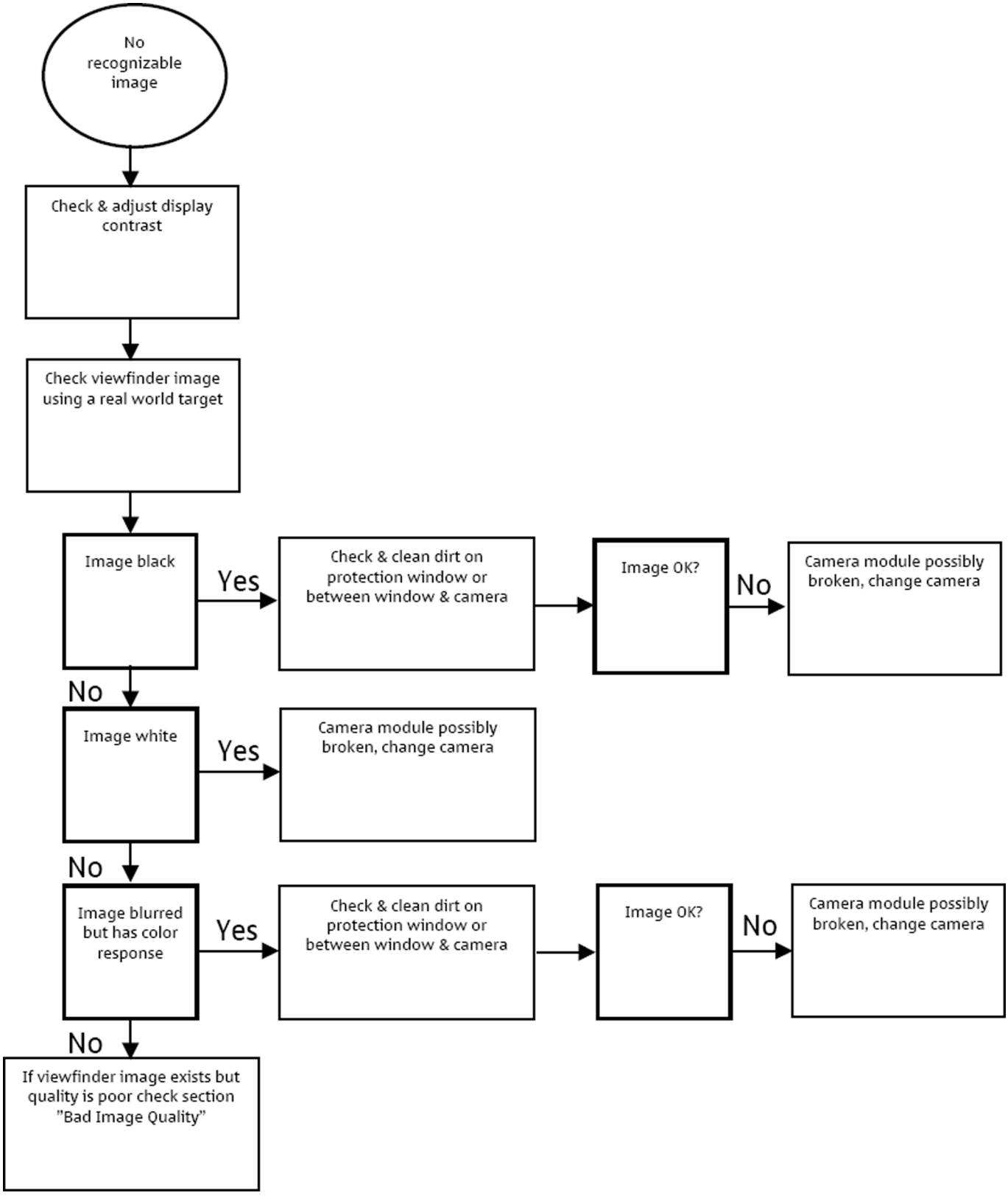
Camera viewfinder troubleshooting

Troubleshooting flow



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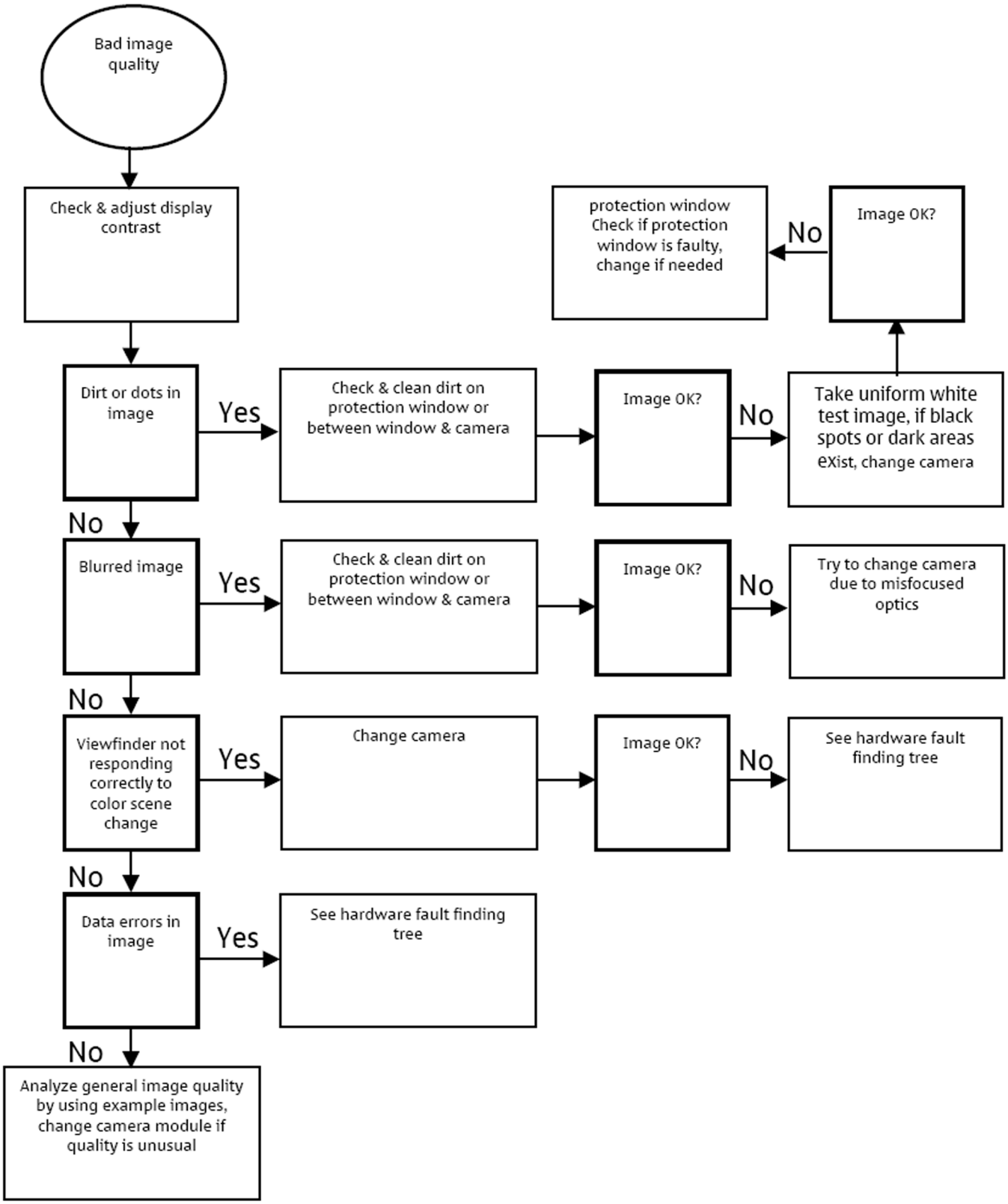
Camera: Bad image quality troubleshooting

Troubleshooting flow



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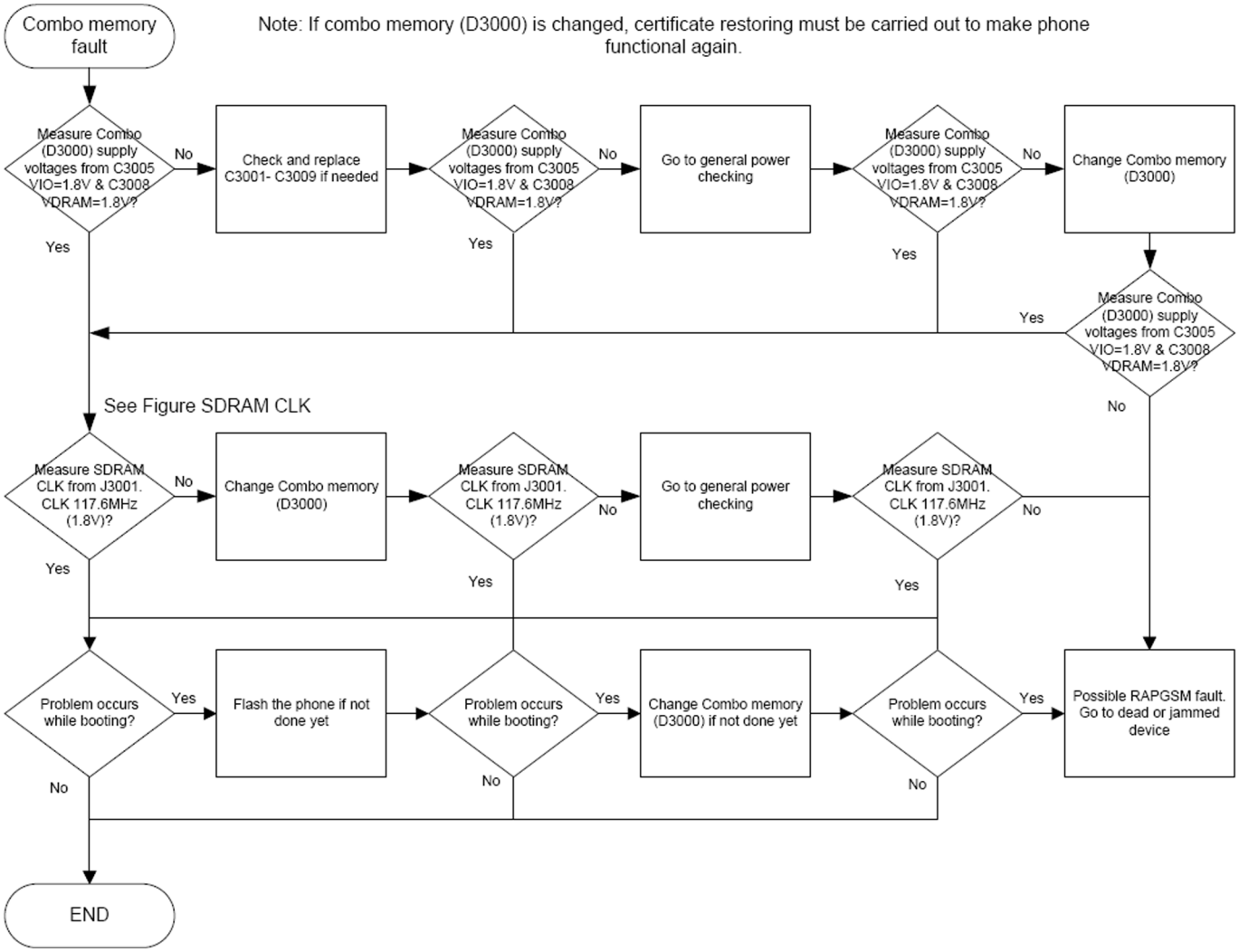
COMBO memory troubleshooting

Troubleshooting flow



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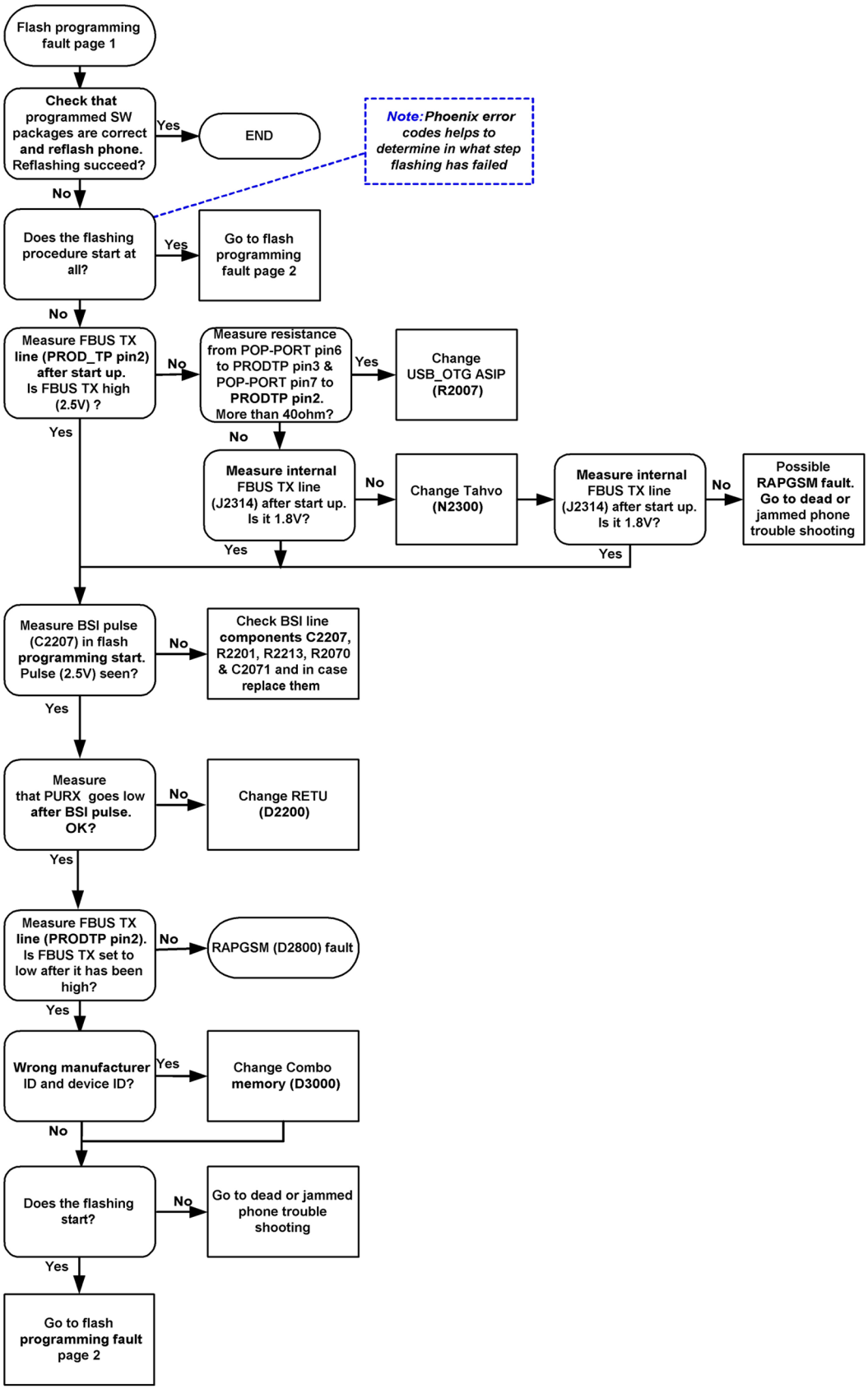
Flash programming fault troubleshooting

Part 1



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Part 2

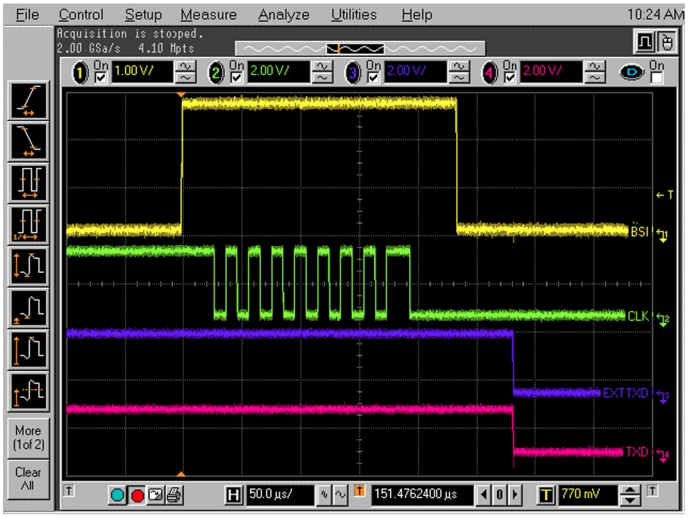

Figure 8 Flashing pic 1. Take single trig measurement for the rise of the BSI signal.

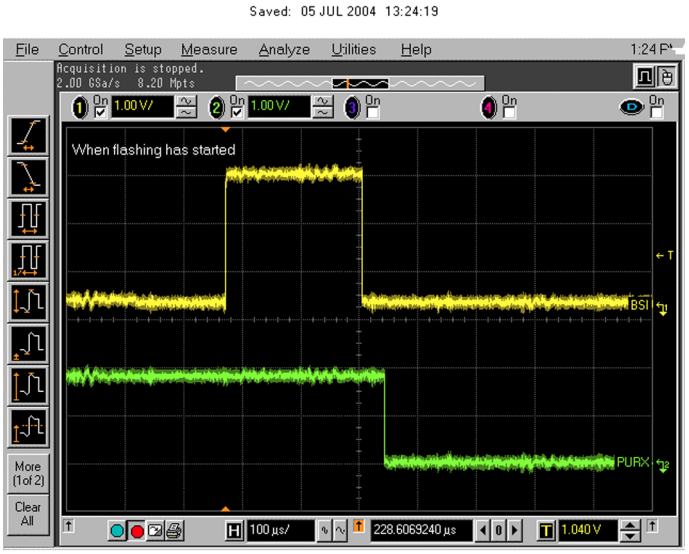

Figure 9 Flashing pic 2. Take single trig measurement for the rise of the BSI signal.

MicroSD card troubleshooting

Context

In the RM-322/323 the microSD card reader is located under the battery cover.

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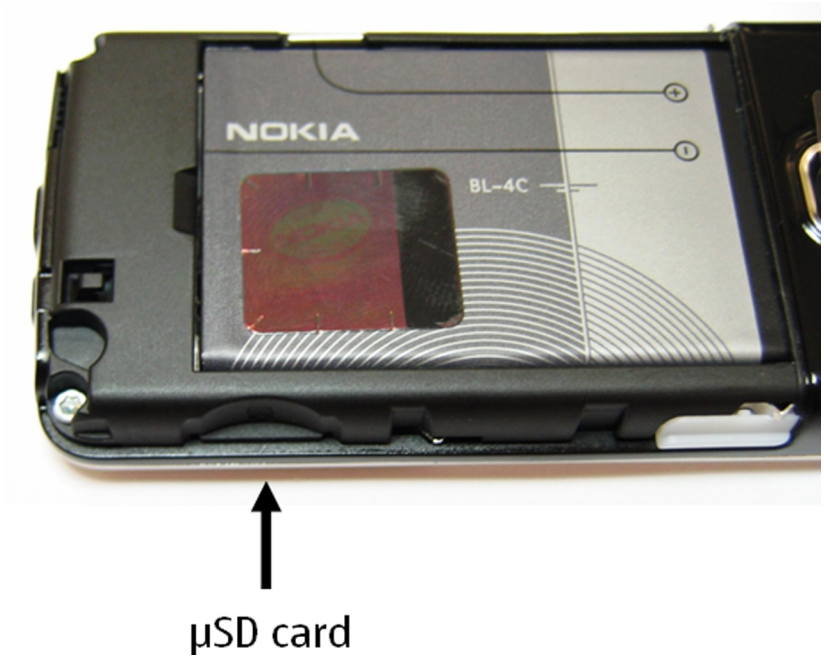

Figure 10 Location of the microSD card reader in RM-322/323

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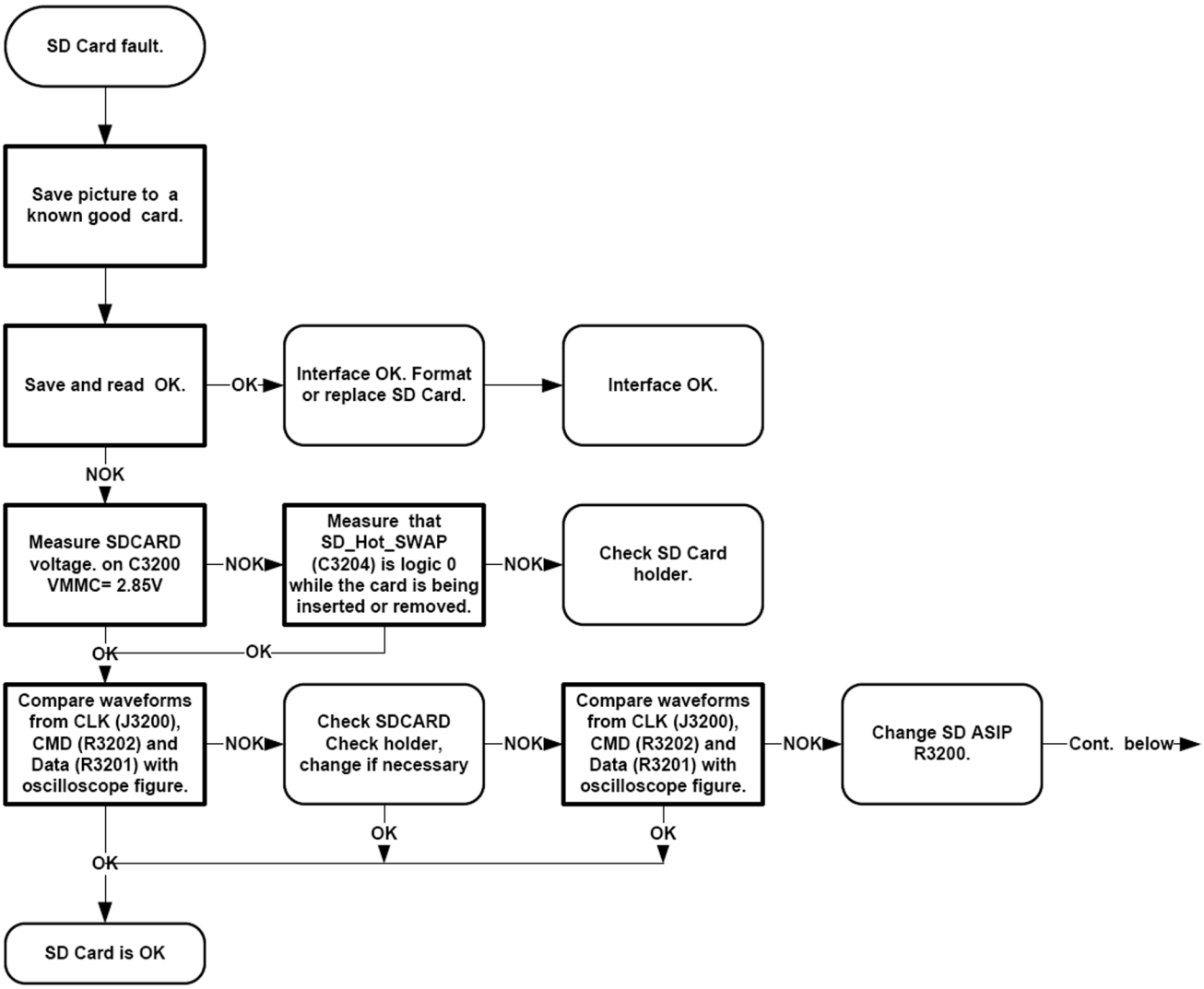
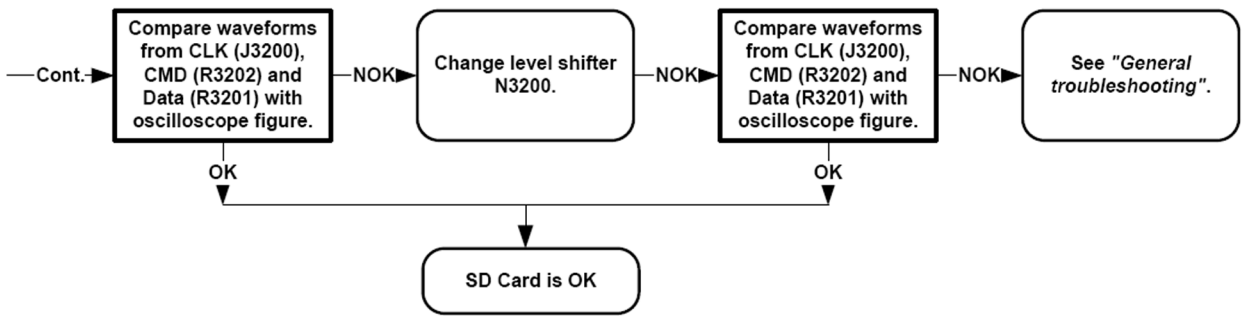
Troubleshooting flow





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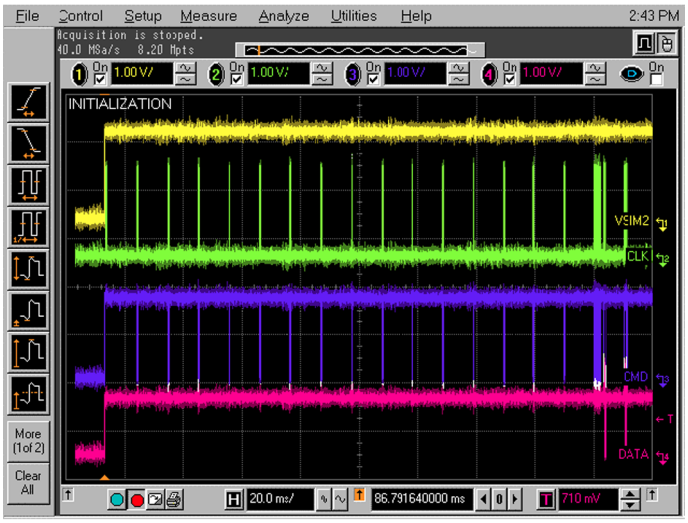

Take single trig measurement on the rising edge of the DAT signal.

Figure 11 SD card initialization from pin J3206

User interface troubleshooting

Display module troubleshooting

General instructions for display troubleshooting

Context

The RM-322/323 has three display modes:

- *Normal mode*: The display is in normal mode when the phone is in active use.
- *Partial idle mode*: The display is in partial idle mode when the power saver is on.
- *Sleep mode*: The display has a sleep mode to conserve power. In this mode the display looks blank, but the phone is switched on. To verify if the phone display is sleeping, press a key.

The operating modes of the display can be controlled with the phone settings menu.

Table 6 Display module troubleshooting cases

Display blank	There is no image on the display. The display looks the same when the phone is on as it does when the phone is off. The backlight can be on in some cases.
Image on the display not correct	Image on the display can be corrupted or a part of the image can be missing. If a part of the image is missing, change the display module. If the image is otherwise corrupted, follow the appropriate troubleshooting diagram.
Backlight dim or not working at all	Backlight LED components are inside the display module. Backlight failure can also be in the connector or in the backlight power source in the main engine of the phone. This means that in case the display is working (image OK), the backlight is faulty.

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Visual defects (pixel)	Pixel defects can be checked by controlling the display with Phoenix. Use both colours, black and white, on a full screen. The display may have some random pixel defects that are acceptable for this type of display. The criteria when pixel defects are regarded as a display failure, resulting in a replacement of the display, are presented the following table.

Table 7 Pixel defects

Item		White dot defect				Black dot defect	Total
1	Defect counts	R	G	B	White Dot Total	1	1
		1	1	1	1		
2	Combined defect counts	Not allowed. Two single dot defects that are within 5 mm of each other should be interpreted as combined dot defect.					

Steps

1. Verify with a working display that the fault is not on the display module itself.
   The display module cannot be repaired.
2. Check that the cellular engine is working normally.
   i To check the functionality, connect the phone to a docking station.
   ii Start *Phoenix* service software.
   iii Read the phone information to check that also the application engine is functioning normally (you should be able to read the APE ID).
3. Proceed to the display troubleshooting flowcharts.
   Use the **Display Test** tool in *Phoenix* to find the detailed fault mode.

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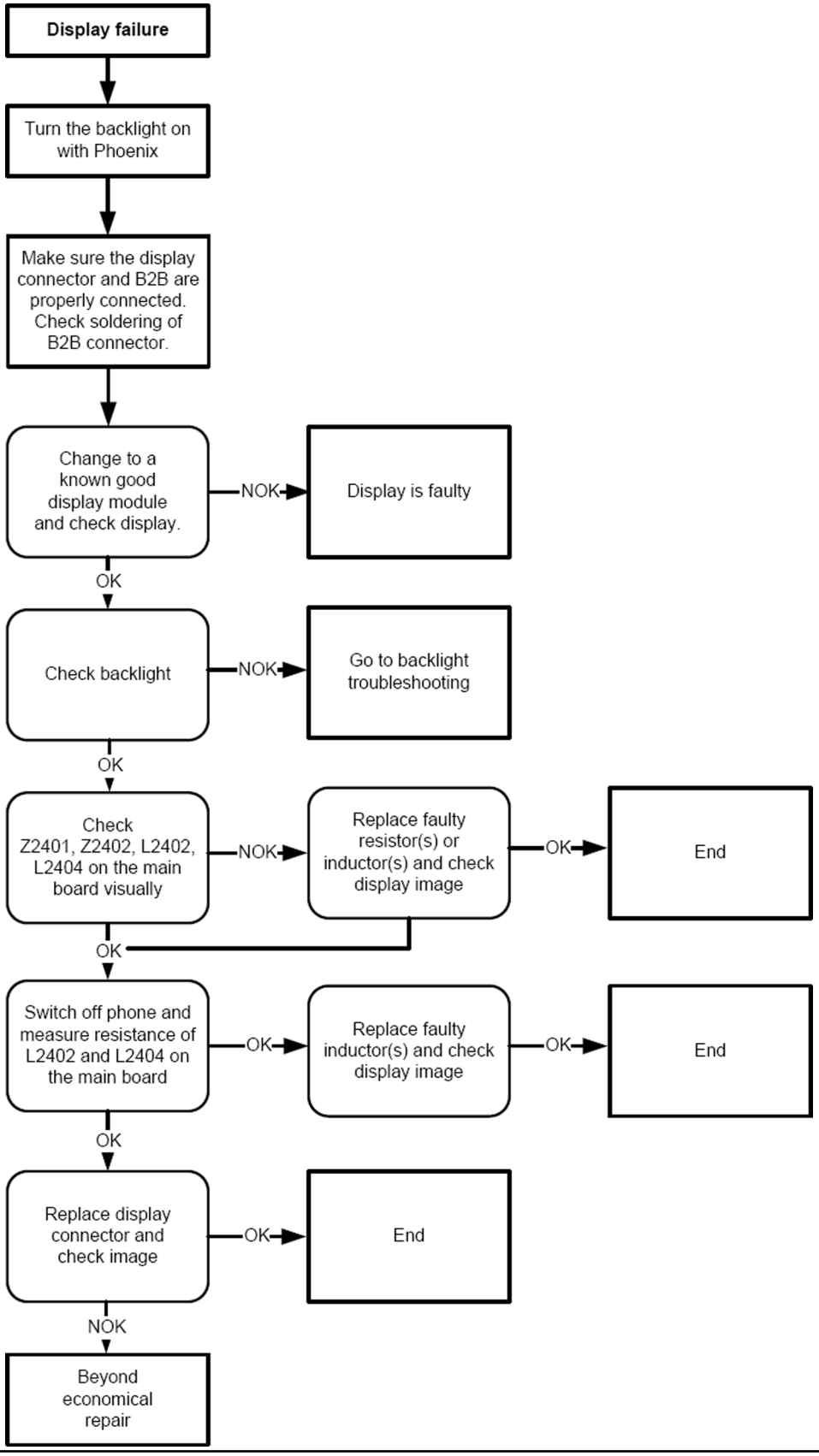
Display troubleshooting

Troubleshooting flow



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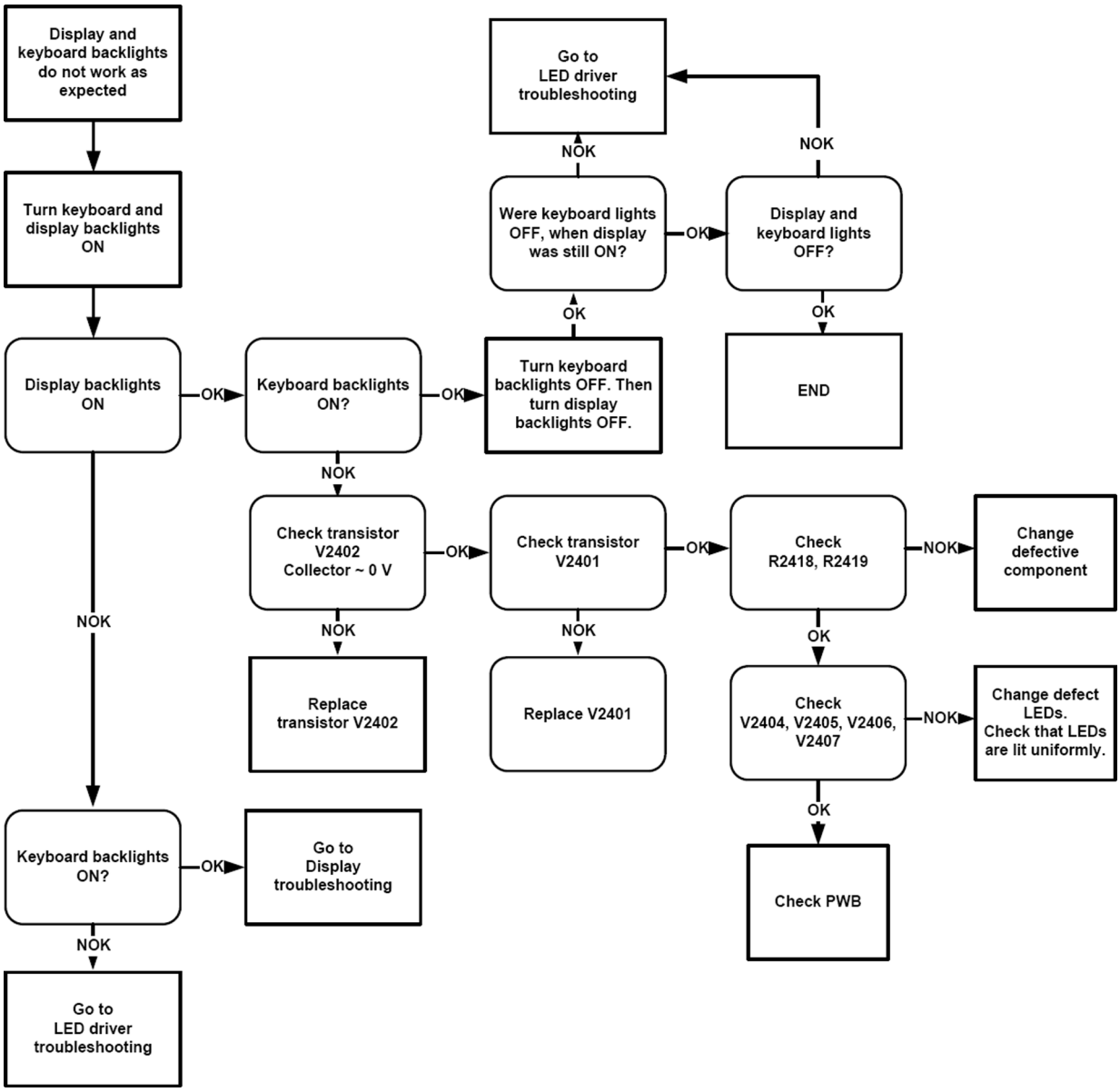
Backlight troubleshooting

Context

The device has one LED driver that provides current for both the display and keyboard backlights. Brightness can be adjusted manually, and it affects both the display and keypad. Keyboard backlights can be turned ON/OFF separately but not without switching on the display lights.

Display and keyboard backlight troubleshooting



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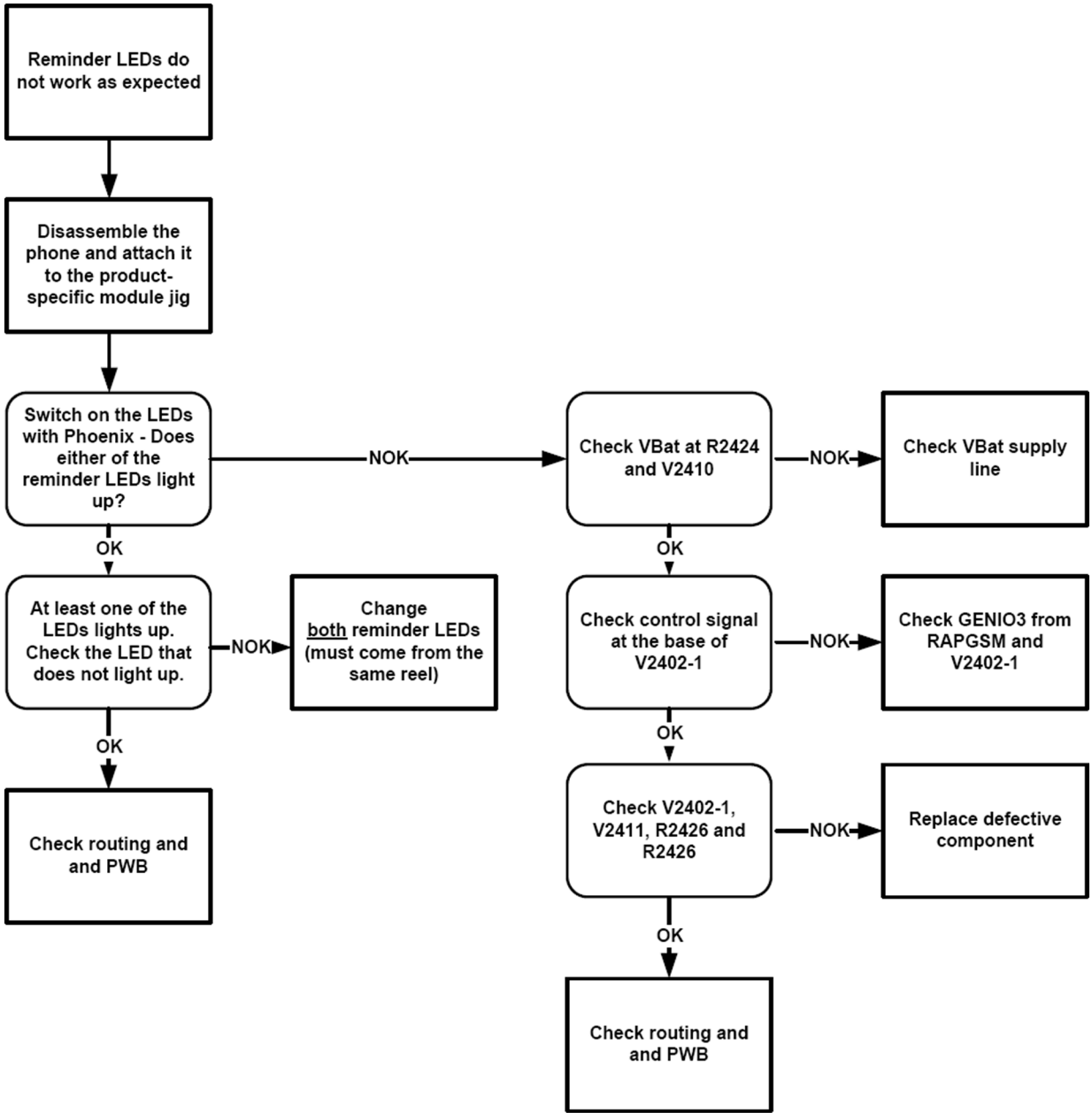
Reminder LED troubleshooting

Troubleshooting flow



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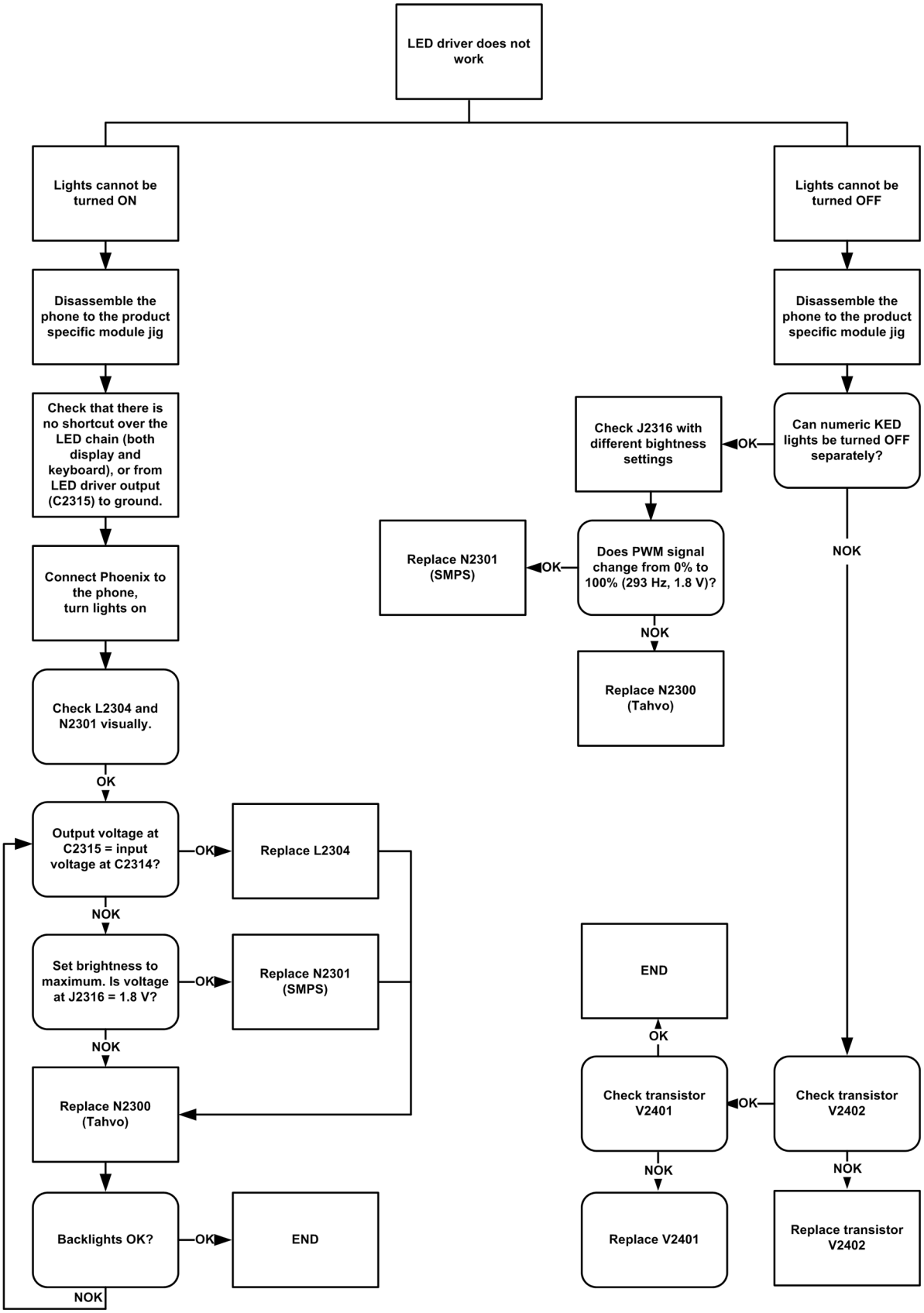
LED driver troubleshooting

LED driver troubleshooting



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Audio troubleshooting

Introduction to acoustics troubleshooting

Note: Always make sure all openings are clean and all contact pads are intact and make contact. If audio still does not work, please continue to the electronic audio troubleshooting (2nd diagram where applicable).

Acoustics design ensures that the sound is detected correctly with a microphone and properly radiated to the outside of the device by speaker(s). The acoustics of the phone includes three basic systems: earpiece, Integrated Hands Free (IHF) and microphone.

The sound reproduced from the earpiece readiates through a single hole on the front cover (A-cover). The sound reproduced from the IHF speaker radiates from a single sound hole located 3 cm below the power key. The microphone is located at the hinge, next to the system connector.

For a correct functionality of the phone, all sound holes must be always open. When the phone is used, care must be taken not to close any of those holes with a hand or fingers. The phone should be dry and clean, and no objects must be located in such a way that they close any of the holes.

Audio troubleshooting test instructions

Differential internal earpiece outputs can be measured either with a single-ended or a differential probe.

When measuring with a single-ended probe each output is measured against the ground.

Internal handsfree output is measured using a current probe, if a special low-pass filter designed for measuring a digital amplifier is not available. Note also that when using a current probe, the input signal frequency must be set to 2kHz.

The input signal for each loop test can be single-ended.

Required equipment

The following equipment is needed for the tests:

- Oscilloscope
- Function generator (sine waveform)
- Current probe (Internal handsfree PWM output measurement)
- Phoenix service software
- Battery voltage 3.7V

Test procedure

Audio can be tested using the Phoenix audio routings option. Three different audio loop paths can be activated:

- External microphone to Internal earpiece
- External microphone to Internal handsfree speaker
- Internal microphone to External earpiece

Each audio loop sets routing from the specified input to the specified output enabling a quick in-out test. Loop path gains are fixed and they cannot be changed using Phoenix. Correct pins and signals for each test are presented in the following table.

Phoenix audio loop tests and test results

The results presented in the table apply when no accessory is connected and battery voltage is set to 3.7V.

Earpiece, internal microphone and speaker are in place during measurement. Applying a headset accessory during measurement causes a significant drop in measured quantities.

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The gain values presented in the table apply for a differential output vs. single-ended/differential input.

Loop test	Input terminal	Output terminal	Path gain [dB] (fixed)	Input voltage [mVp-p]	Differential output voltage [mVp-p]	Output DC level [V]	Output current [mA]
External Mic to External Earpiece	XMICP and GND	HSEAR R and GND	-2.9	1000	720	1.2	NA
		HSEAR L and GND					
External Mic to Internal Earpiece	XMICP and GND	EarP and GND	-4.0	750	490	1.2	NA
		EarN and GND					
External Mic to Internal handsfree	XMICP and GND	E2101 pad	8.5	920	2520	0	25mA (calc.)
		E2102 pad					
Internal Mic to External Earpiece	B2100 (OUT/ GND)	HSEAR R and GND	22.7	100	1360	1.2	NA
		HSEAR L and GND					

Measurement data

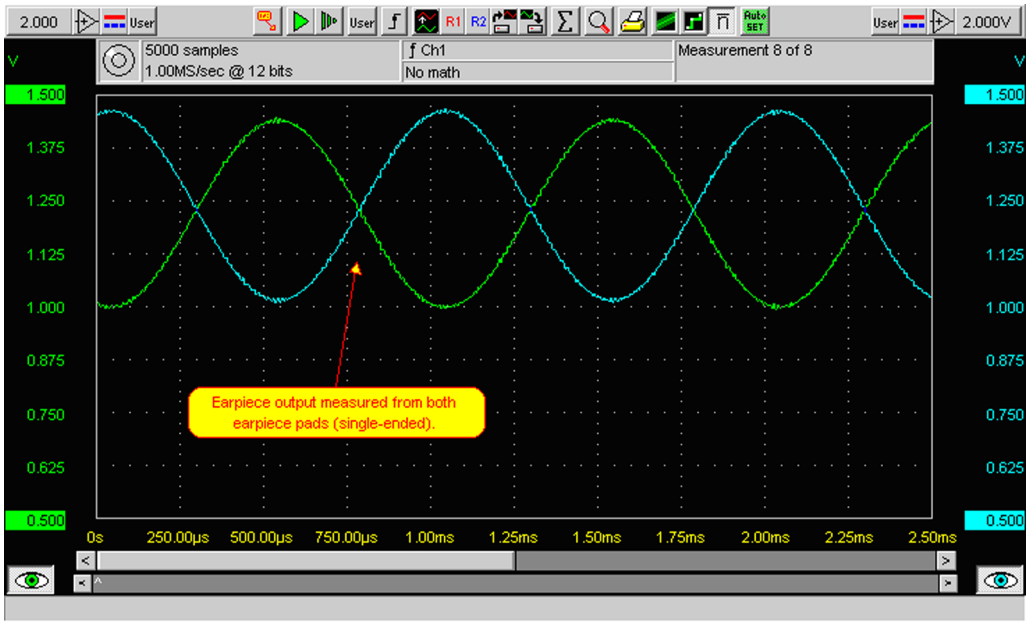

Figure 12 Single-ended output waveform of the Ext_in_HP_out measurement when earpiece is connected.

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Figure 13 Differential output waveform of the Ext_in_IHF_out out loop measurement when speaker is connected.

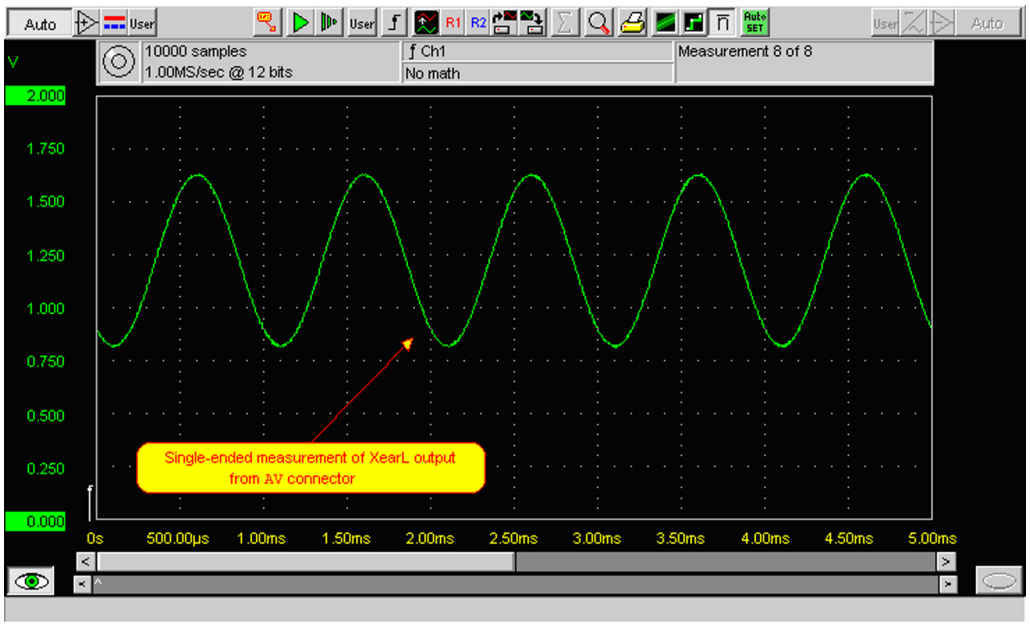

Figure 14 Single-ended output waveform of the HP_in_Ext_out loop when microphone is connected.

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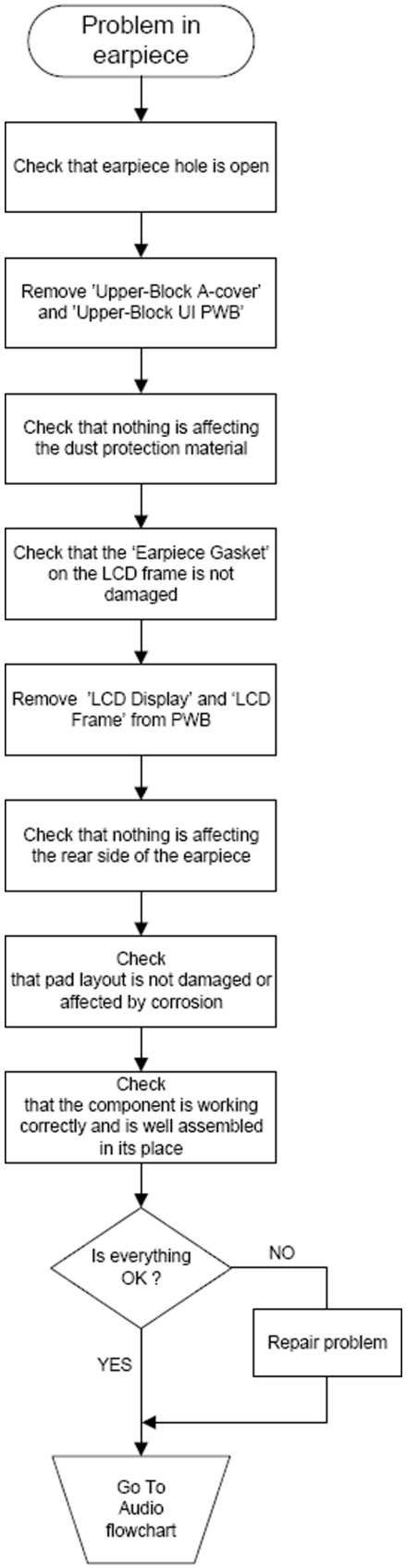
Earpiece troubleshooting

Troubleshooting flow



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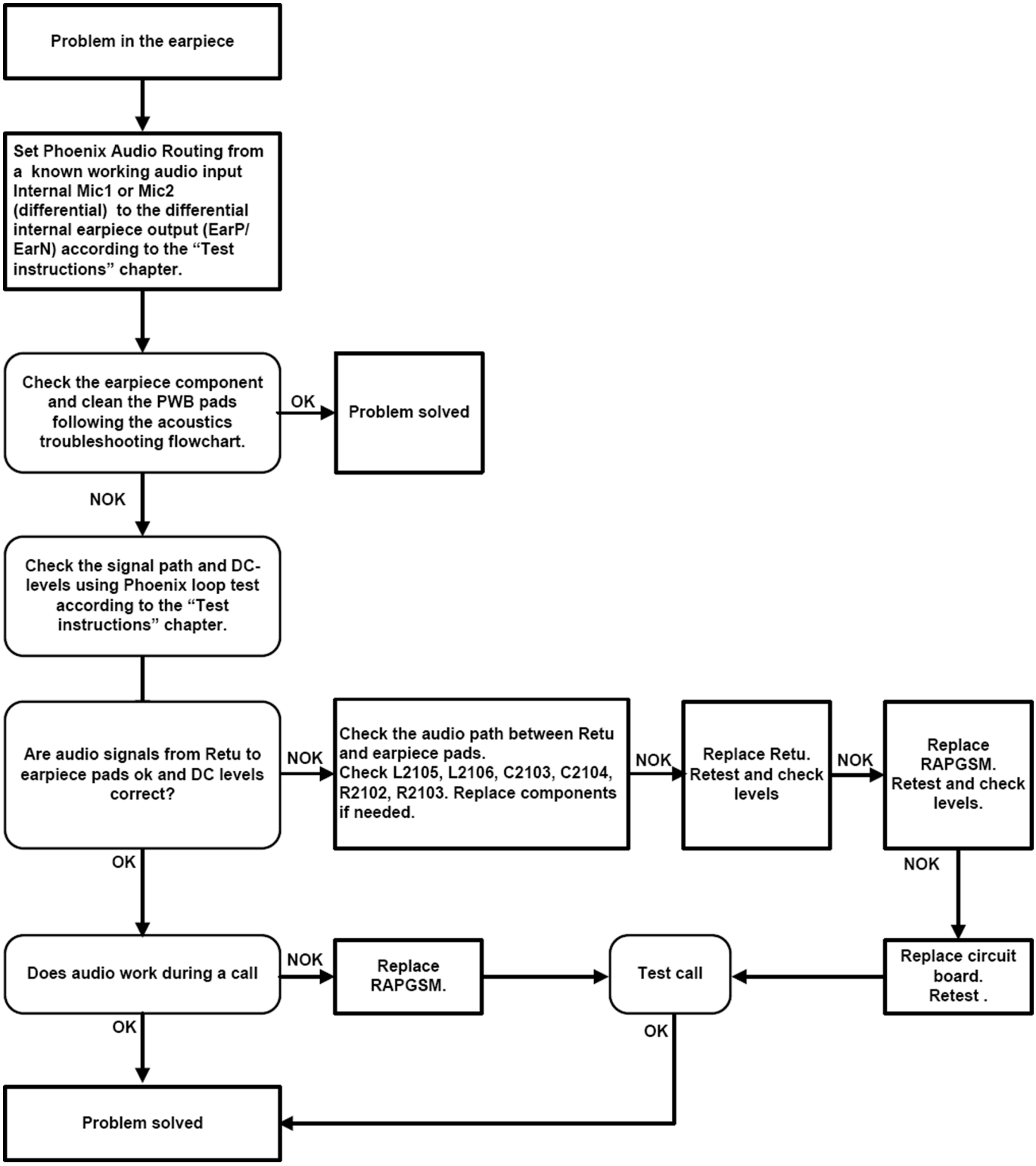
Internal earpiece troubleshooting

Troubleshooting flow



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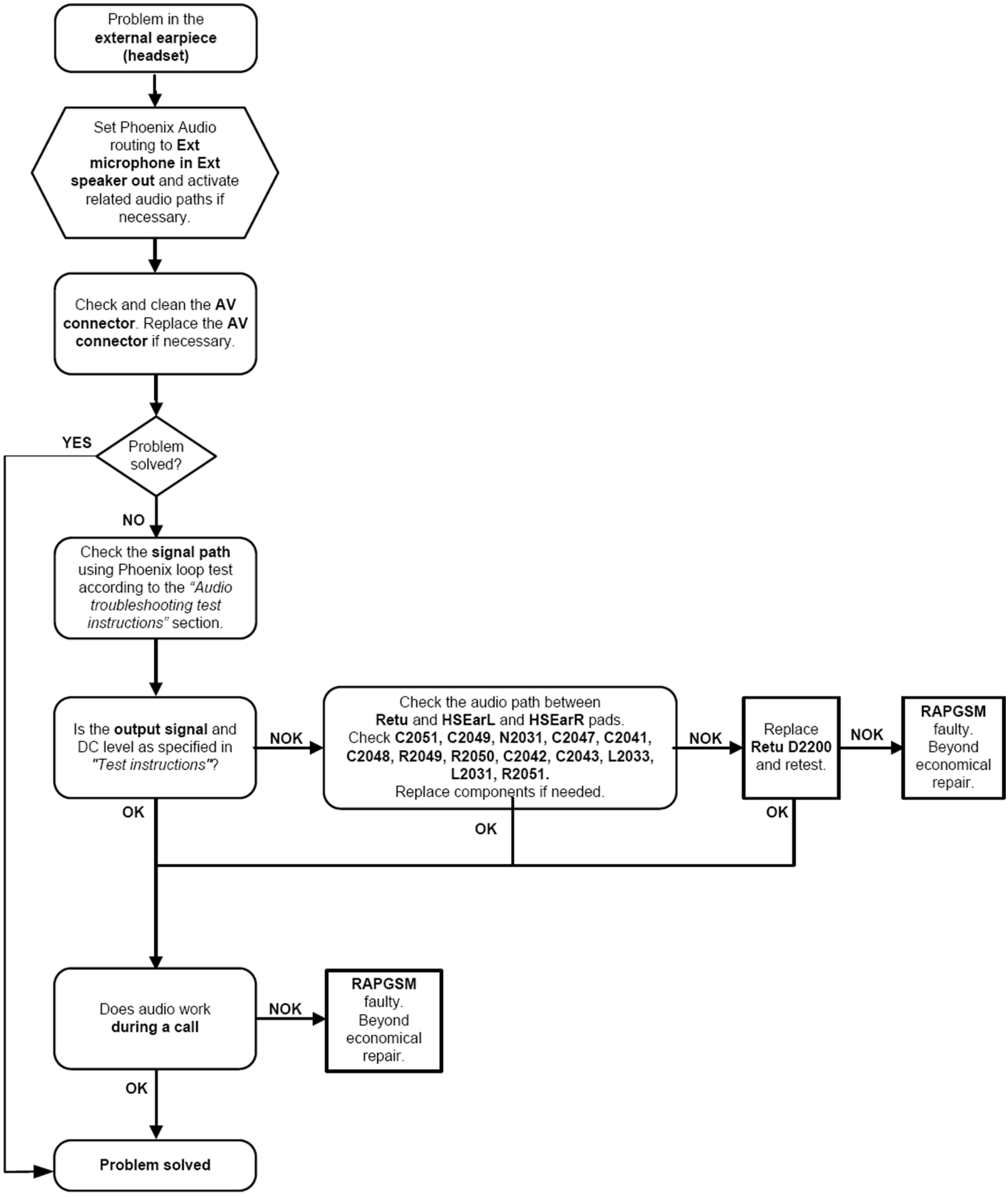
External headset earpiece troubleshooting

Troubleshooting flow



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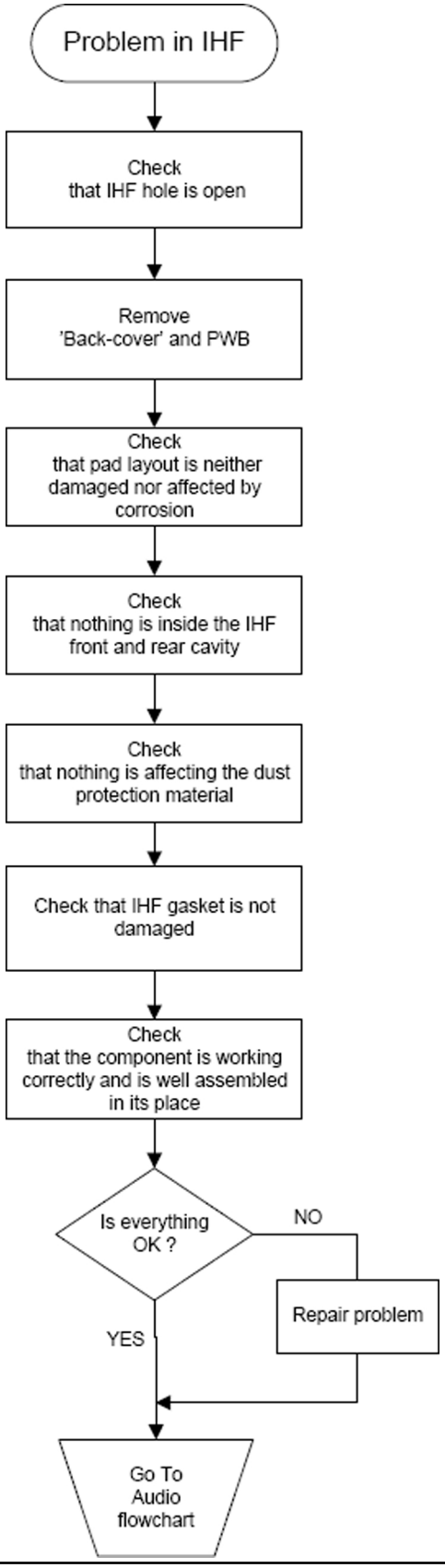
IHF troubleshooting

Troubleshooting flow



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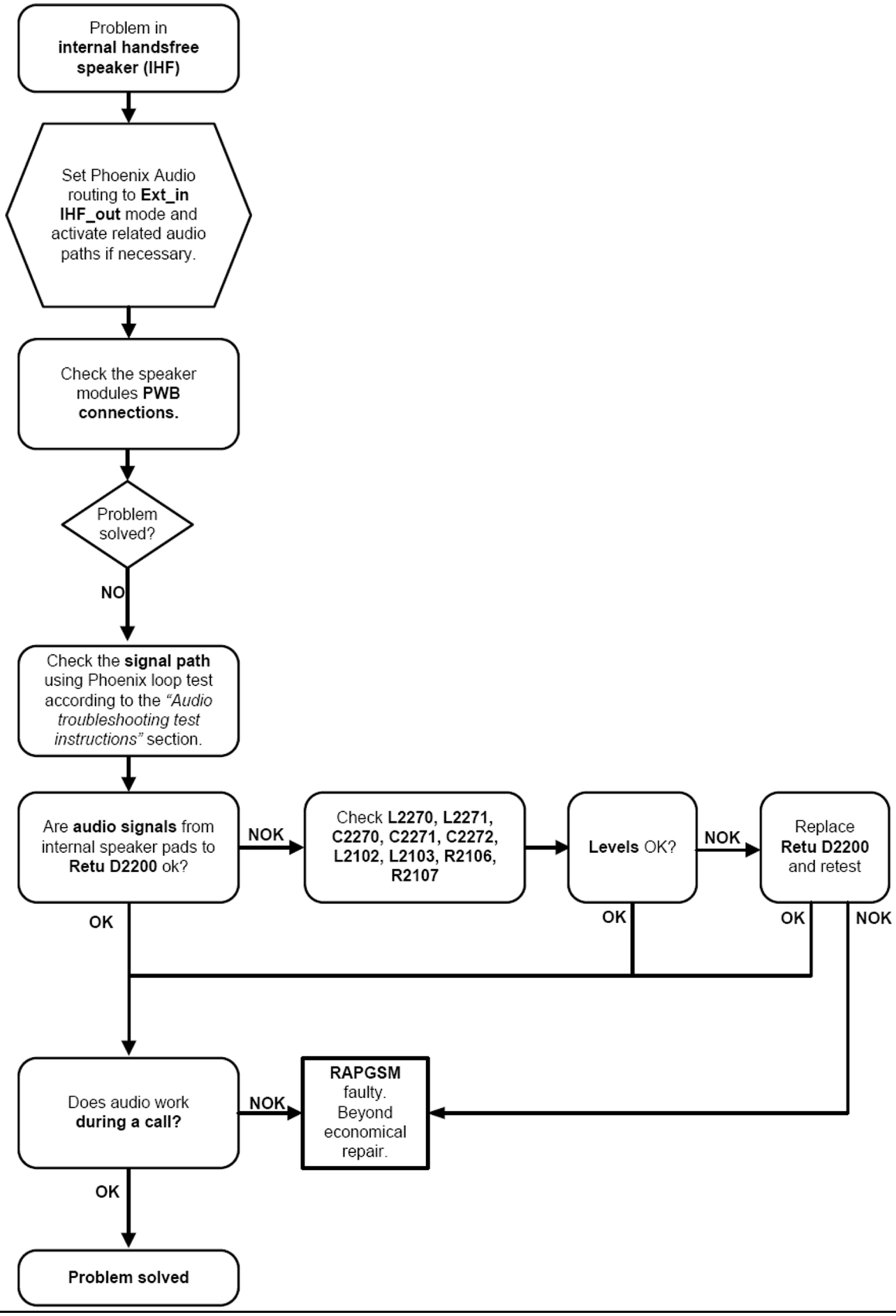
IHF troubleshooting

Troubleshooting flow



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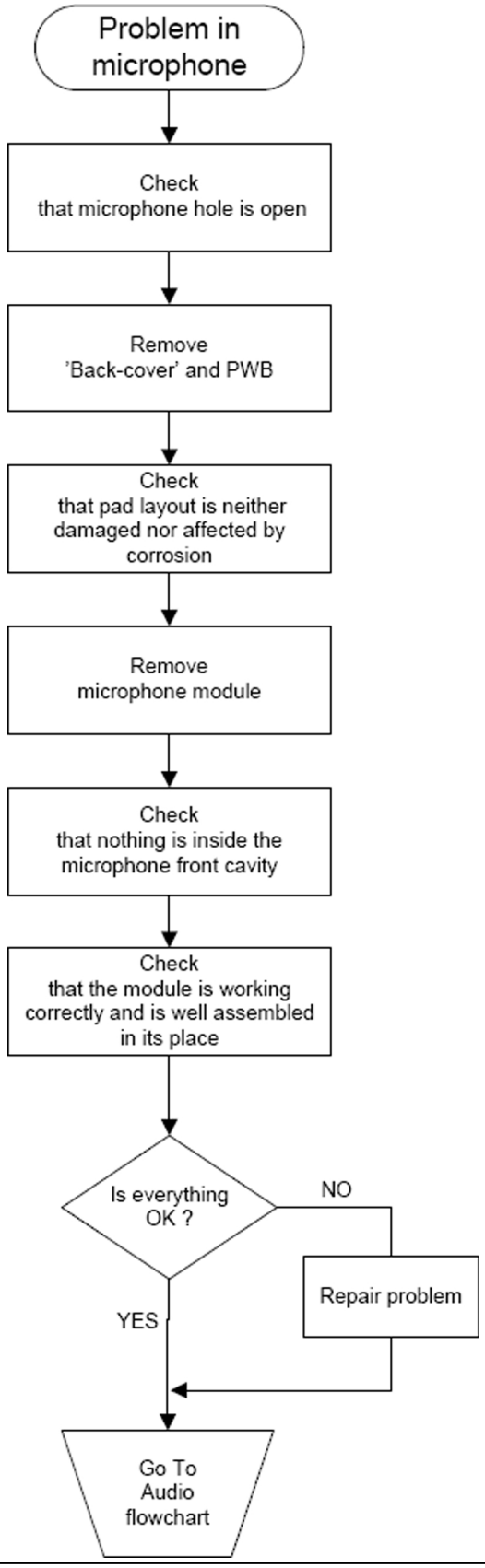
Microphone troubleshooting

Troubleshooting flow



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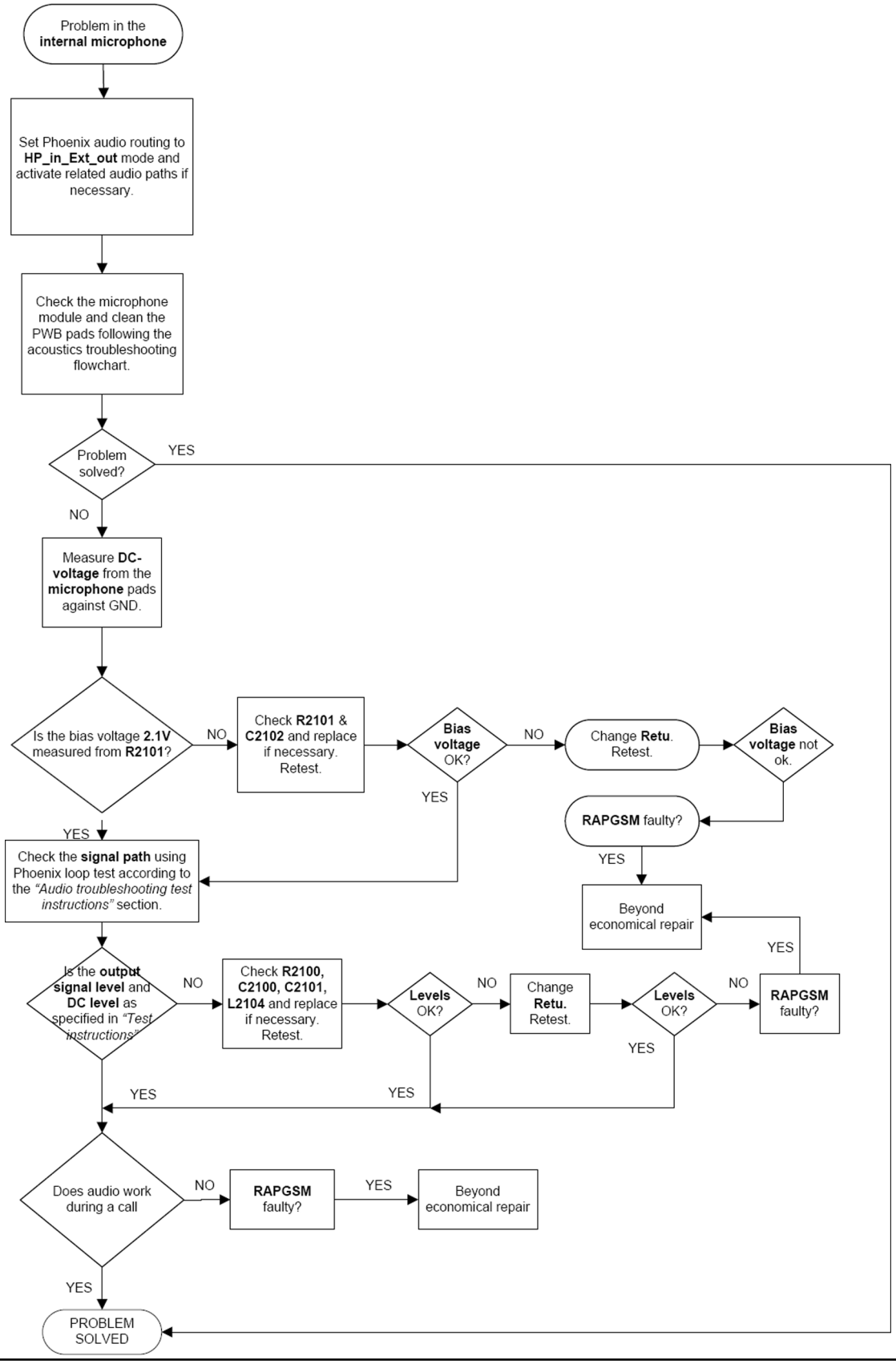
Internal microphone troubleshooting

Troubleshooting flow



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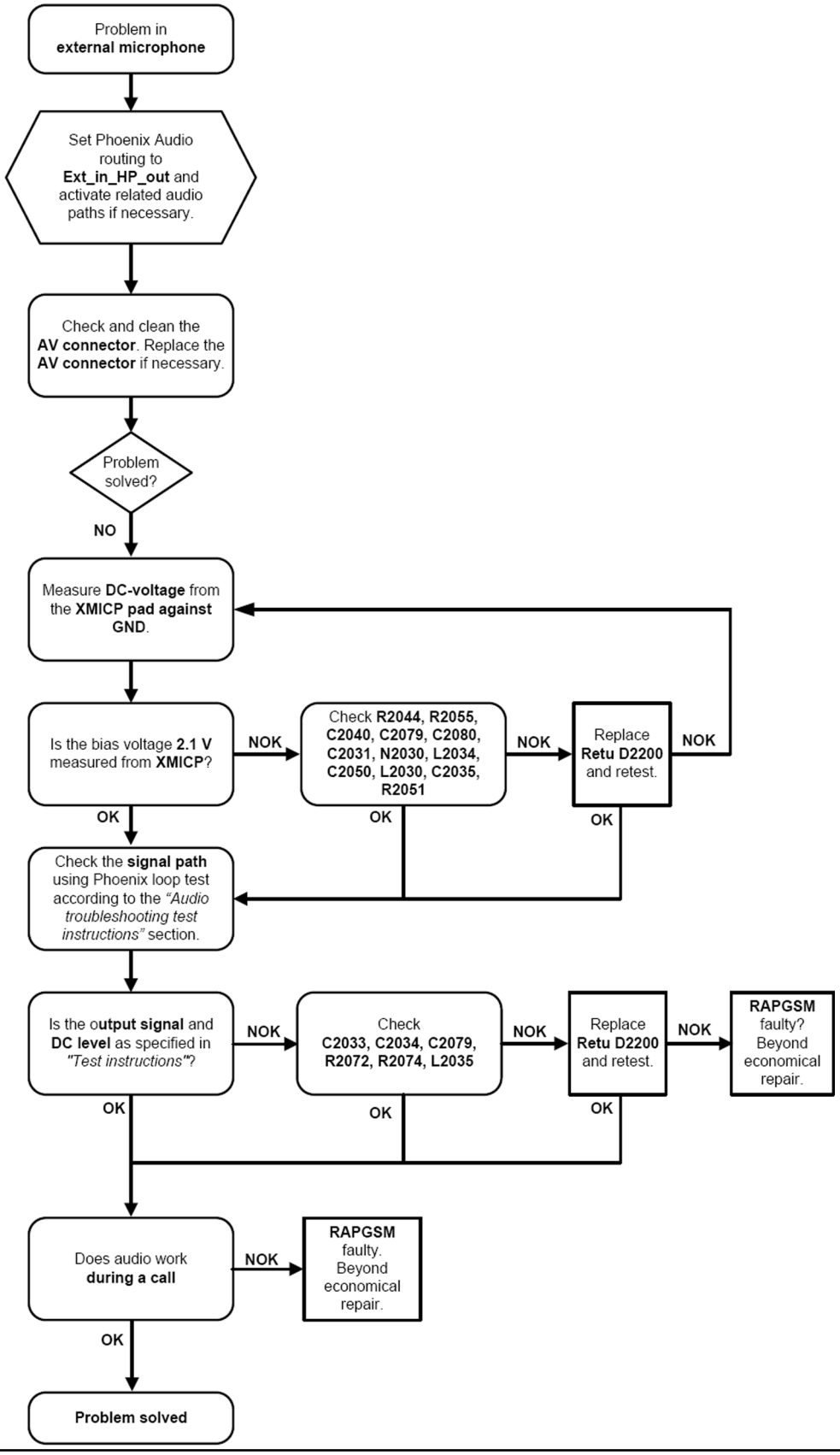
External headset microphone troubleshooting

Troubleshooting flow



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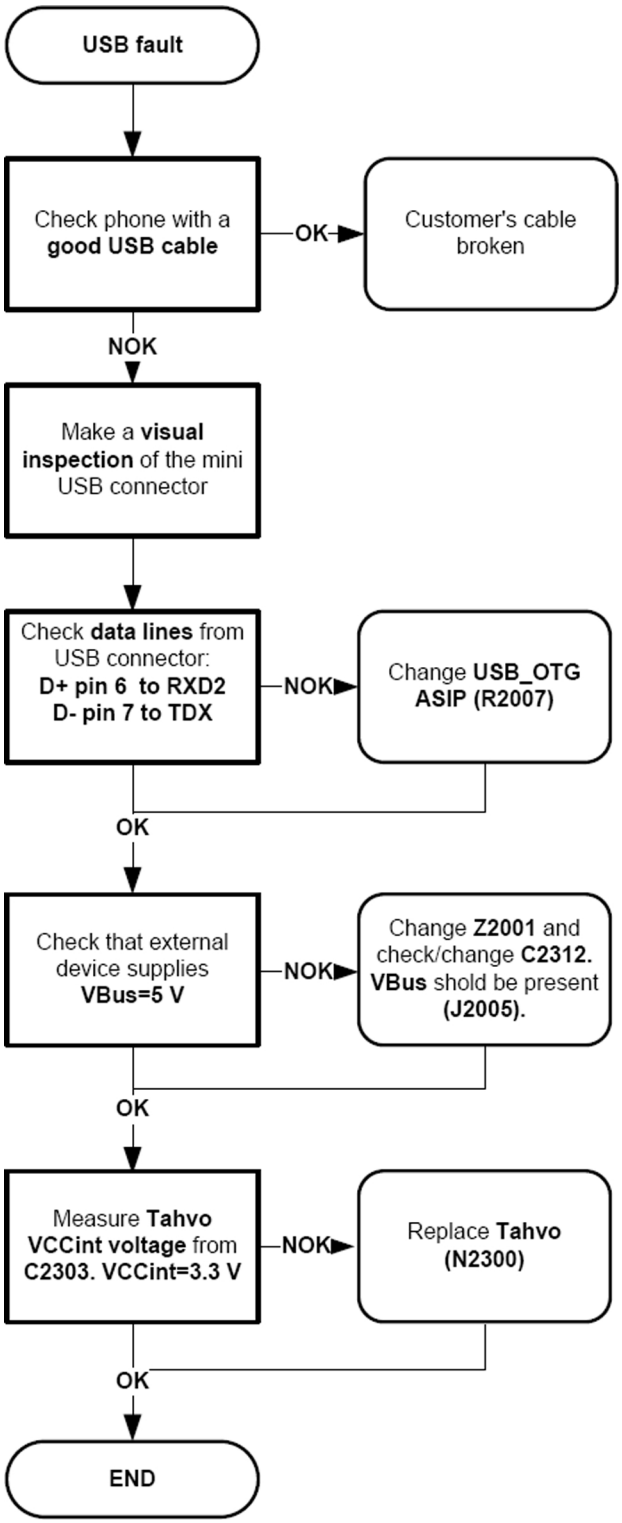
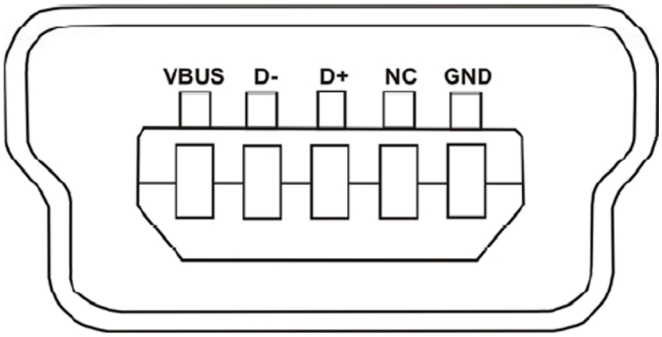
Connections troubleshooting

USB interface troubleshooting

Troubleshooting flow





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Baseband manual tuning guide

Certificate restoring for BB5 products

Context

This procedure is performed when the device certificate is corrupted for some reason.

All tunings (RF & Baseband, UI) must be done after performing the certificate restoring procedure.

The procedure for certificate restoring is the following:

- Flash the phone with the latest available software using FPS-8 or FPS-10.
- Create a request file.
- Send the file to Nokia by e-mail. Use the following addresses depending on your location:
  - APAC: sydney.service@nokia.com
  - CHINA: repair.ams@nokia.com
  - E&A: salo.repair@nokia.com
  - AMERICAS: fls1.usa@nokia.com
- When you receive a reply from Nokia, carry out certificate restoring.
- Tune the phone completely.

  Note: SX-4 smart card is needed.
- If the phone resets after certificate restoring, reflash the phone again.

Required equipment and setup:

- *Phoenix* service software v 2007.34.8.30060 or newer.
- The latest phone model specific *Phoenix* data package.
- PKD-1 dongle
- SX-4 smart card (Enables BB5 testing and tuning features)
- External smart card reader

  Note: The smart card reader is only needed when FPS-8 is used. FPS-10 has an integrated smart card reader.
- Activated FPS-8 flash prommer **OR** FPS-10 flash prommer
- Flash update package 03.18.004 or newer for FPS-8 or FPS-10 flash prommers
- CU-4 control unit
- USB cable from PC USB Port to CU-4 control unit
- Phone model specific adapter for CU-4 control unit
- PCS-1 cable to power CU-4 from external power supply
- XCS-4 modular cable between flash prommer and CU-4

  Note: CU-4 must be supplied with +12 V from an external power supply in all steps of certificate restoring.

Steps

1. Program the phone software.
   i Start *Phoenix* and login. Make sure the connection has been managed correctly for FPS-8 or FPS-10.
   ii Update the phone MCU software to the latest available version.

   If the new flash is empty and the phone cannot communicate with *Phoenix*, reflash the phone.

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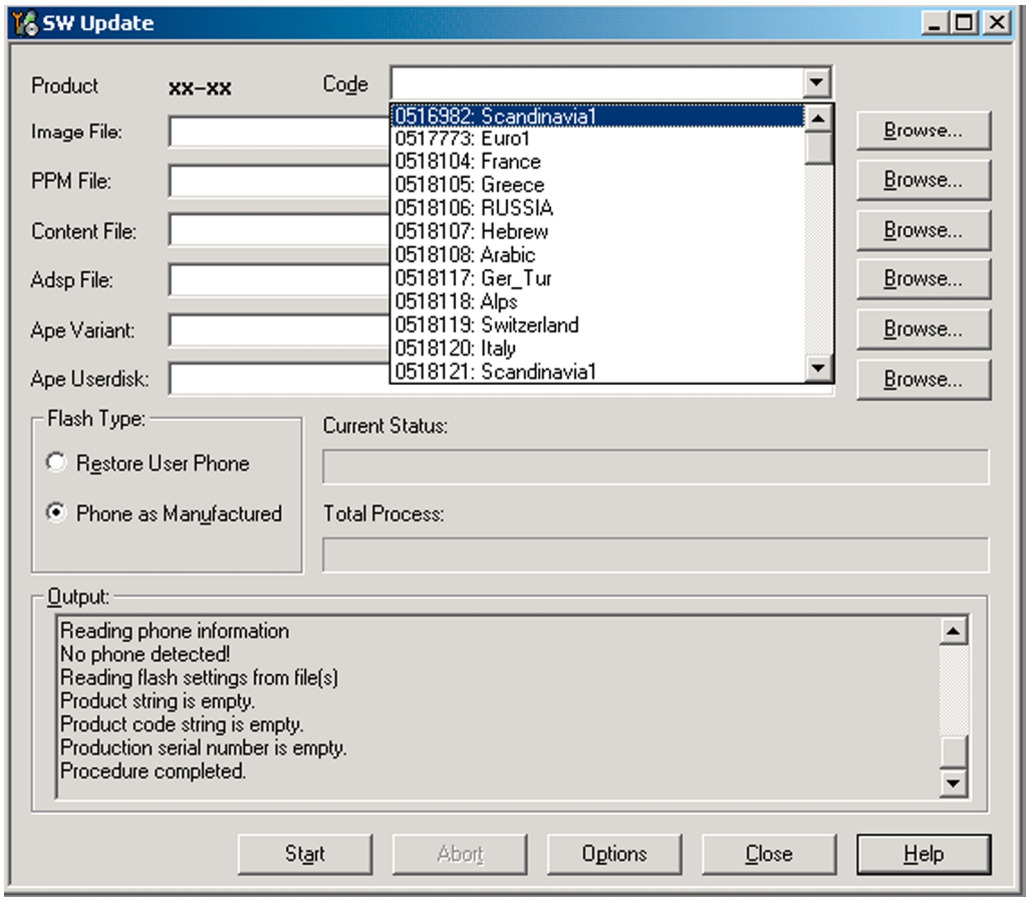
iii Choose the product manually from **File→Open Product** , and click **OK**.

Wait for the phone type designator (e.g. "RM-1") to be displayed in the status bar.

iv Go to **Flashing→SW Update** and wait until *Phoenix* reads the product data as shown in the following picture.



Product	is automatically set according to the phone support module which was opened manually, but the flash files cannot be found because the correct data cannot be read from the phone automatically.
Code	must be chosen manually, it determines the correct flash files to be used. Please choose the correct product code (can be seen in the phone type label) from the dropdown list.
Flash Type	must be set to **Phone as Manufactured**.

v To continue, click **Start**.

Progress bars and messages on the screen show actions during phone programming, please wait.

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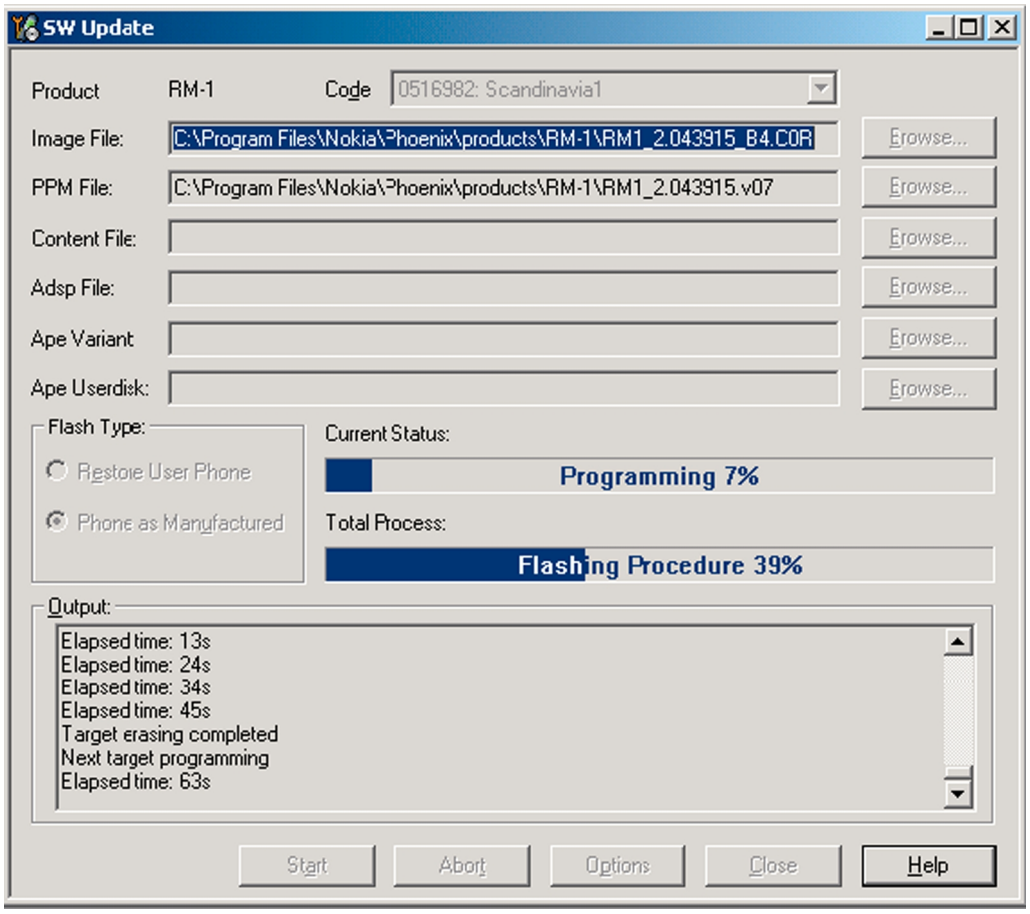


Programming is completed when *Flashing Completed* message is displayed.

The product type designator and MCU SW version are displayed in the status bar.

vi Close the *SW Update* window and then choose **File→Close Product** .

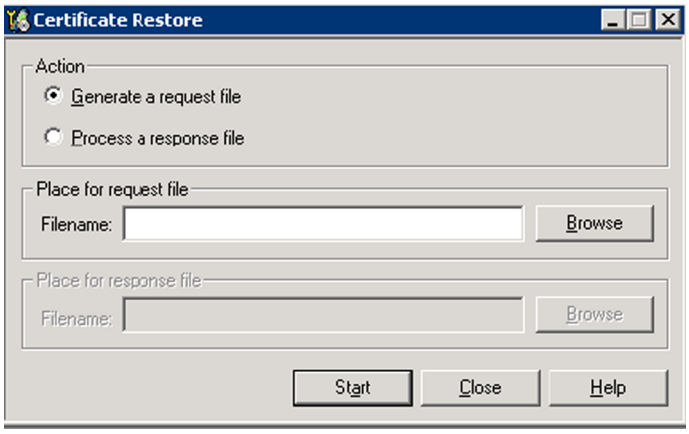
2. Create a *Request* file.

For this procedure, you must supply +12 V to CU-4 from an external power supply.

i To connect the phone with *Phoenix*, choose **File→Scan Product** .

ii Choose **Tools→Certificate Restore** .

iii To choose a location for the request file, click **Browse**.



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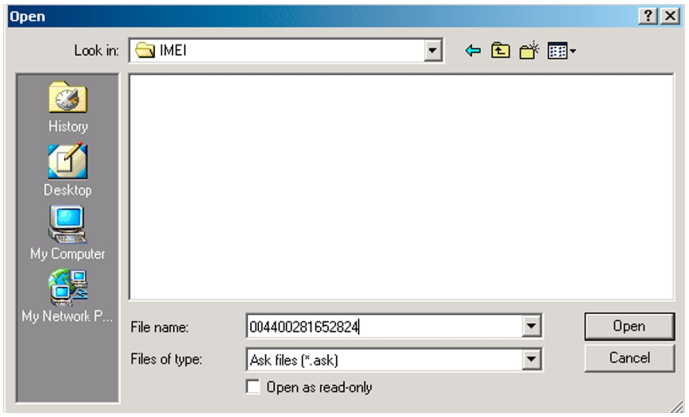
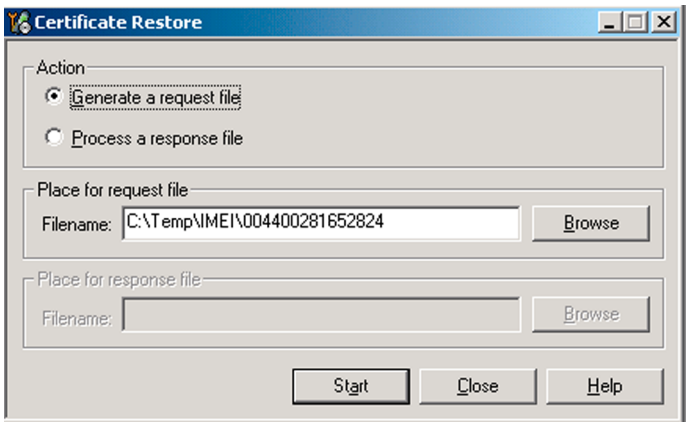
iv Name the file so that you can easily identify it, and click **Open**.



The name of the file and its location are shown.



v To create the *Request* file, click **Start**.

vi When the file for certificate restore has been created, send it to Nokia as an e-mail attachment.

3. Restore certificate.

For this procedure, you must supply +12 V to CU-4 from an external power supply.

i Save the reply file sent by Nokia to your computer.

ii Start *Phoenix* service software.

iii Choose **File→Scan Product** .

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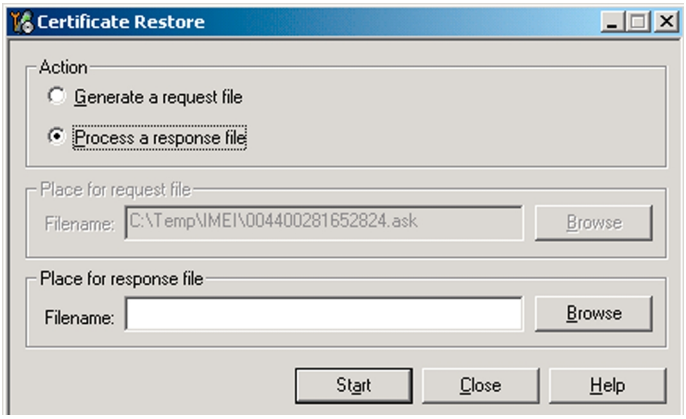
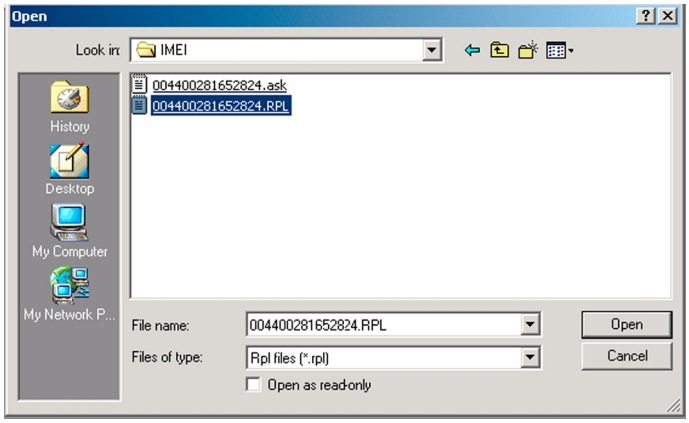
iv From the **Tools** menu, choose **Certificate Restore** and select **Process a response file** in the *Action* pane.



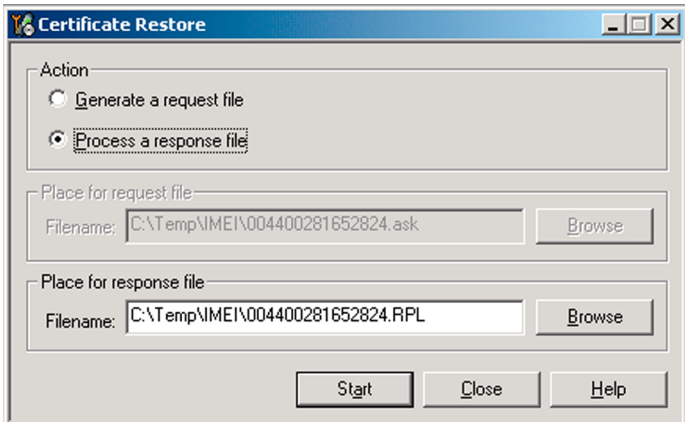
v To choose the location where response file is saved, click **Browse**.

vi Click **Open**.



The name of the file and the path where it is located are shown.

vii To write the file to phone, click **Start**.



Next actions

After a successful rewrite, you must retune the phone completely by using *Phoenix* tuning functions.

Important: Perform all tunings: RF, BB, and UI.

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Energy management calibration

Prerequisites

Energy Management (EM) calibration is performed to calibrate the setting (gain and offset) of AD converters in several channels (that is, **battery voltage**, **BSI**, **battery current**) to get an accurate AD conversion result.

Hardware setup:

- An external power supply is needed.
- Supply 12V DC from an external power supply to CU-4 to power up the phone.
- The phone must be connected to a CU-4 control unit with a product-specific flash adapter.

Steps

1. Place the phone to the docking station adapter (CU-4 is connected to the adapter).
2. Start *Phoenix* service software.
3. Choose **File→ Scan Product.**
4. Choose **Tuning→Energy Management Calibration.**
5. To show the current values in the phone memory, click **Read**, and check that communication between the phone and CU-4 works.
6. Check that the **CU-4 used** check box is checked.
7. Select the item(s) to be calibrated.

   Note: ADC calibration has to be performed before other item(s). However, if all calibrations are selected at the same time, there is no need to perform the ADC calibration first.
8. Click **Calibrate**.

   The calibration of the selected item(s) is carried out automatically.

   The candidates for the new calibration values are shown in the *Calculated values* column. If the new calibration values seem to be acceptable (please refer to the following "Calibration value limits" table), click **Write** to store the new calibration values to the phone permanent memory.

Table 8 Calibration value limits

Parameter	Min.	Max.
ADC Offset	-20	20
ADC Gain	12000	14000
BSI Gain	1100	1300
VBAT Offset	2400	2650
VBAT Gain	19000	23000
VCHAR Gain	N/A	N/A
IBAT (ICal) Gain	7750	12250

9. Click **Read**, and confirm that the new calibration values are stored in the phone memory correctly. If the values are not stored to the phone memory, click **Write** and/or repeat the procedure again.
10. To end the procedure, close the *Energy Management Calibration* window.

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4 — RF Troubleshooting and Manual Tuning Guide

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Introduction to RF troubleshooting

On the following pages you will find a step-by-step troubleshooting procedure and reference measurements at the relevant signal points. For functional descriptions, please refer to the System module section.

Notes on reference measurements

All measurements must be done using:

- spectrum analyser with a high-frequency high-impedance passive probe (LO-/reference frequencies and RF power levels)
- oscilloscope with a 10:1 probe (DC-voltages and low frequency signals)

> **Important:** All measurements with an RF coupler must be performed in an RF shielded environment, or where there are no transmissions on the same frequencies. This may disturb sensitive receiver measurements.

Repairing this phone - important

The RF section of the phone is built around one RF ASIC. Before changing the RF ASIC, please make sure that supply voltages and serial communication coming from baseband to RF are OK.

Please note that the grounding of the FEM module is directly below the FEM module. Therefore, it is difficult to check or change the module.

Most RF semiconductors are static discharge sensitive! ESD protection must be taken care of during repair (ground straps and ESD soldering irons). The RF ASIC and FEM are moisture sensitive, so parts must be pre-baked prior to soldering.

In addition to key components, there are lot of discrete components (resistors, inductors and capacitors) which troubleshooting is done mainly by checking if the soldering of the component is done properly.

Capacitor can be checked for shorts and resistors for value by means of an ohmmeter, but be aware in-circuit measurements should be evaluated carefully.

Keep in mind that all measured voltages or RF levels depicted in the service manual are rough figures. Especially RF levels vary because of different measuring equipment or different grounding of the probe used.

When using an RF probe, use a pair of metallic tweezers to connect the probe ground to the PWB ground as close to the measurement point as possible. If measurements are performed in a product specific module jig, then “GND” pads should be used for the probe ground.

Supported bands

The following part of the service manual contains a description of all four GSM bands. It covers both variants, RM-322 and RM-323. Both variants support three GSM bands as follows:

- **RM-322**: GSM900, GSM1800, GSM1900
- **RM-323**: GSM850, GSM1800, GSM1900

Make sure to investigate only the bands, which the phone is made for.

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RF key components

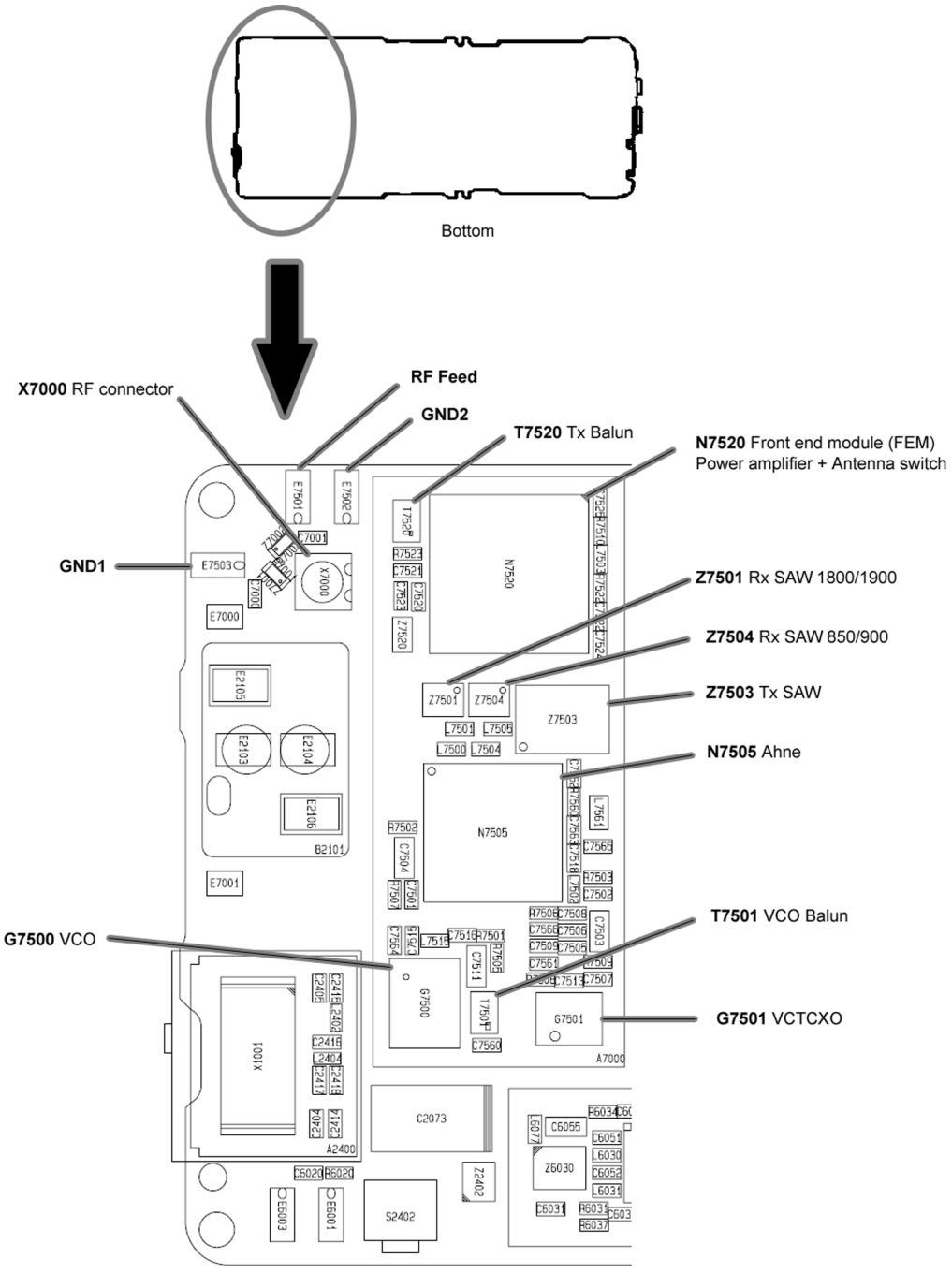

Figure 15 RF key components, bottom side main board

Receiver troubleshooting

Introduction to RX troubleshooting

Rx can be tested by making a phone call or in the local mode. For the local mode testing, use Phoenix service software.

The main Rx troubleshooting measurement is RSSI measurement. This test measures the signal strength of the received signal. I and Q branches can be measured separately.

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In GSM, the input signal can be either a real GSM signal or a CW signal that is 67.771kHz up from the carrier frequency.

For service tool usage instructions, refer to section Service Tools and Service Concepts.

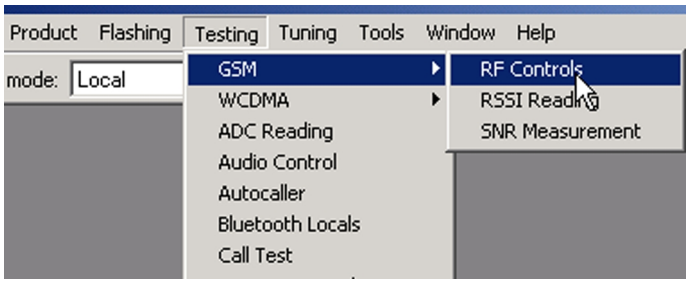
General instructions for RX troubleshooting

Steps

1. Connect a test jig to a computer with a DAU-9S cable or to a FPS-10 flash prommer with a modular cable (XCS-4).

   Make sure that you have a PKD-1 dongle connected to the computer's parallel port.
2. Connect CU-4 with 12 V supply. The DC supply voltage is set to 3.7 V by default (in Phoenix).
3. Connect an RF cable between the RF connector of the module test jig (MJ-156) and measurement equipment or alternatively use a 50 Ω (at least 2 W) dummy load in the module test jig RF connector, otherwise the RF part may be damaged.

   Note: Make sure that all connections are made to the correct RF connector.
4. Set Rx on.
   i Set the phone module to the test jig and start *Phoenix service software*.
   ii Initialize connection to the phone. (With the FPS-10 prommer use FPS10_USB or FPS10_TCP drivers, depending on connection type. When using DAU-9S select FBUS).
   iii From the File menu, choose product: **File -> Choose Product -> xx-x*** (* = type designator of the phone, eg. RM-322/323), or press **Ctrl + R** to scan product.
   iv From the toolbar, set operating mode to “Local”.
5. EGSM850/900/1800/1900 troubleshooting
   i From the Testing menu, activate the *RF Controls* window: **Testing -> GSM -> RF Controls** .



   ii In the *RF Controls* window:
   - Select band.
   - Set Active unit to “Rx” (Default).
   - Set Operation mode to “Burst” (Default).
   - Set Rx/Tx channel (see table below).
   - Apply a frequency (see table below) to the RF-connector.

     Note: Remember to compensate for cable attenuation, specific for MJ-156. You will find the values in the Service tools section.

     Apply a signal to the RF-connector (remember to compensate for cable attenuation). See values in the table below.

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Band	Channel (RX and TX)	Input frequency (MHz)	Offset (kHz)	Power level (dBm)
GSM850	190	881.66771	67.710	-90
GSM900	37	942.46771	67.710	-90
GSM1800	700	1842.86771	67.710	-90
GSM1900	661	1960.06771	67.710	-90

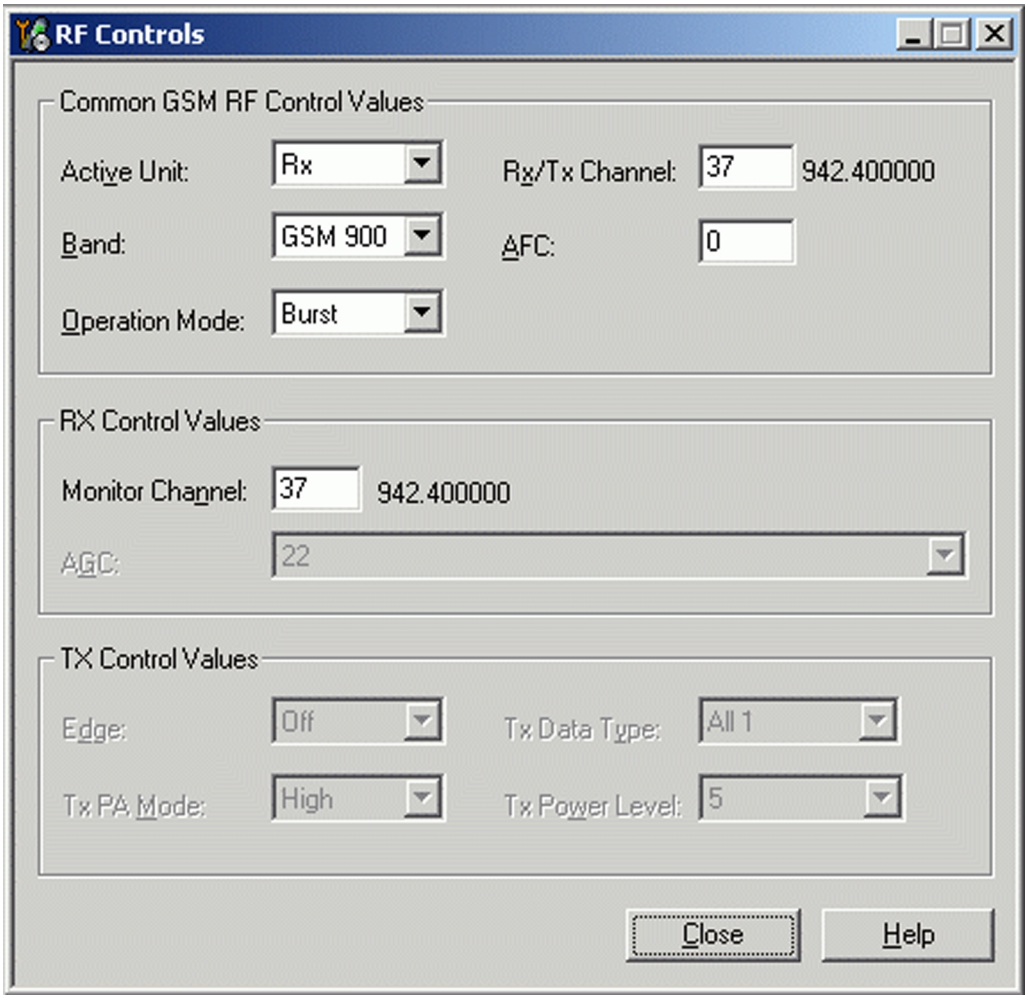

Figure 16 RF Controls window

Receiver (RX) troubleshooting

Context

Troubleshoot one band at a time. Start with the lowest band, and end with GSM1900.

Receiver troubleshooting

Apply a signal according to the table in General instructions for RX troubleshooting (page 4–7)

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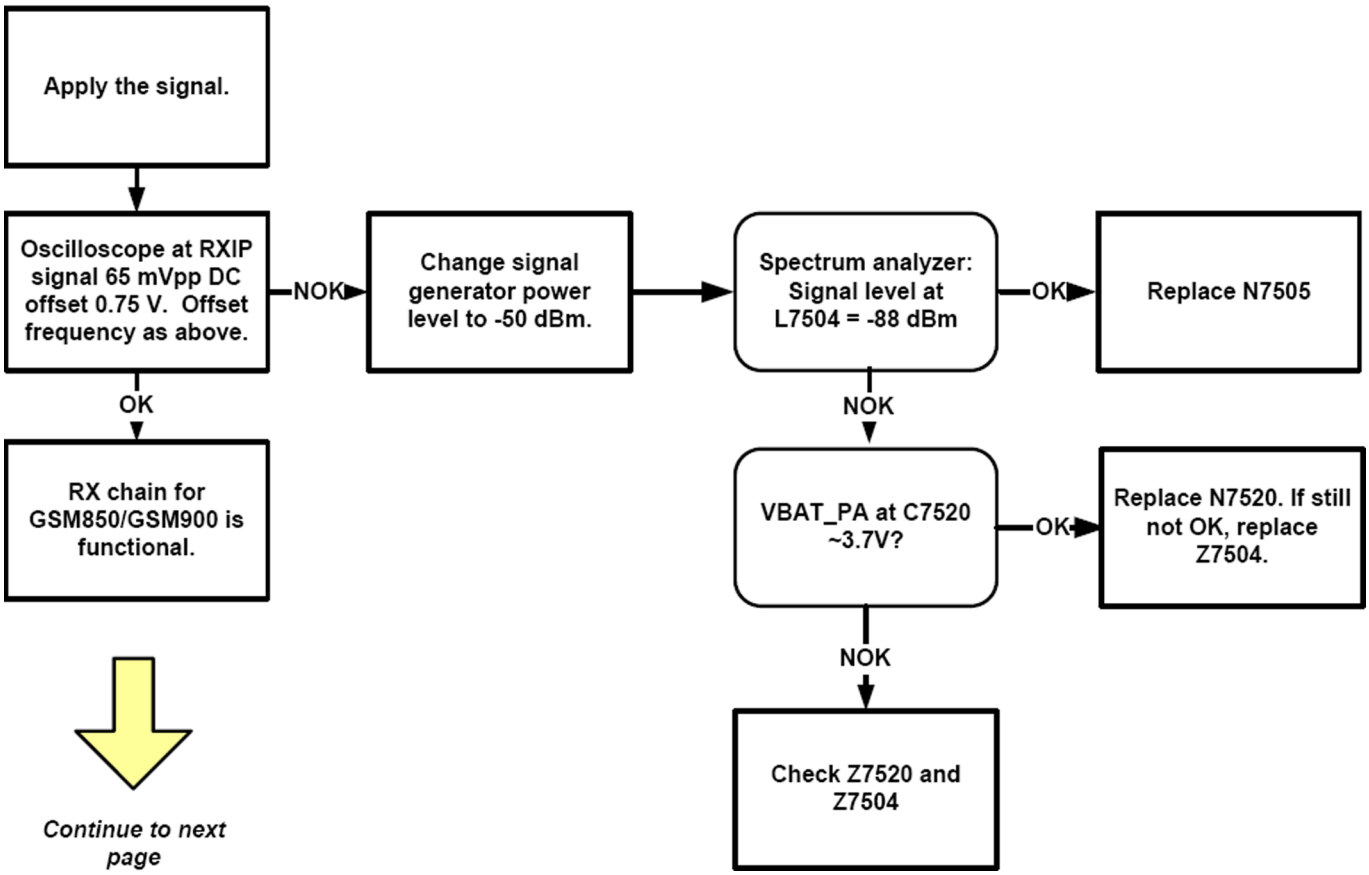
GSM850 or GSM900



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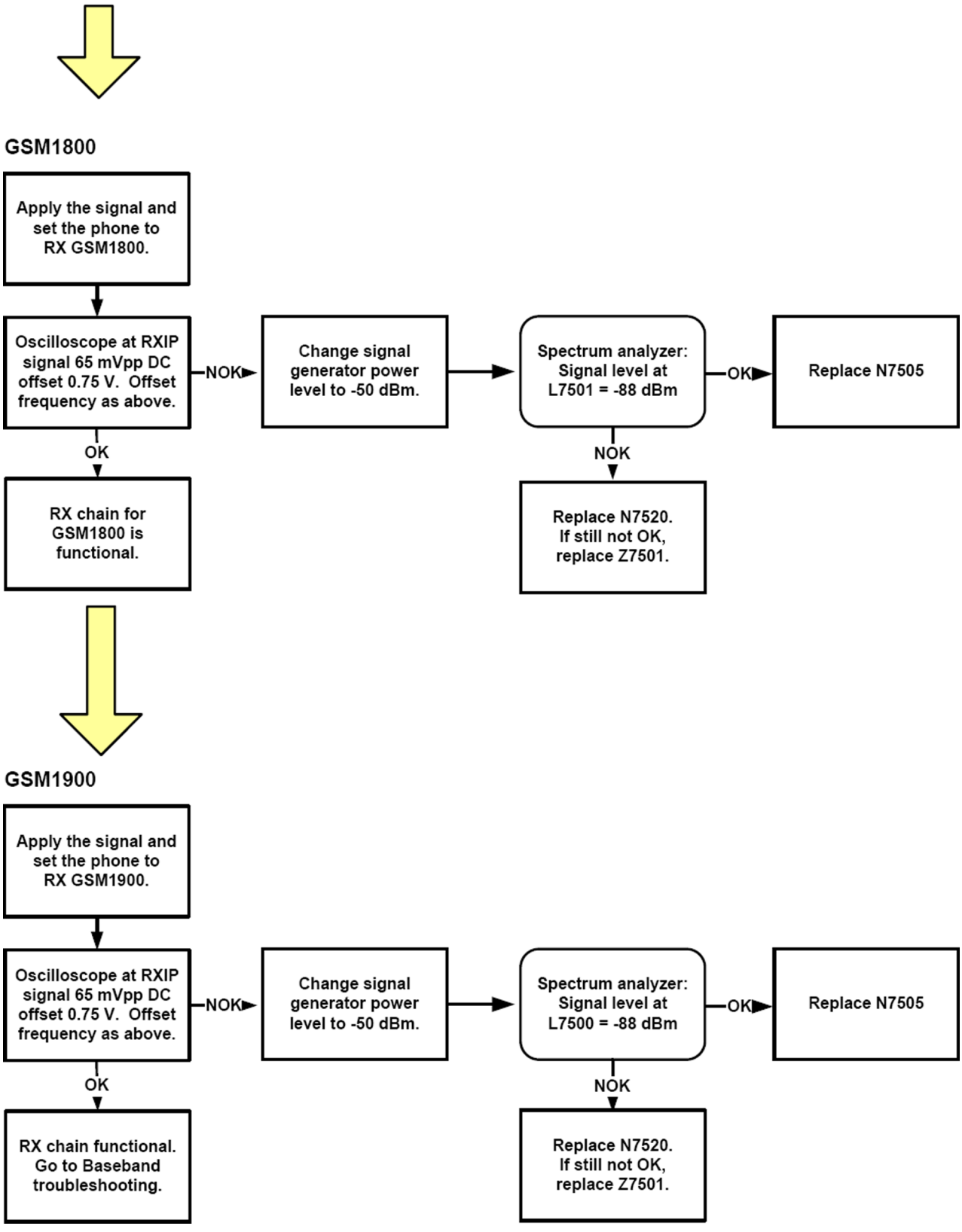
Continued from previous page



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GSM Rx chain activation for manual measurements / GSM RSSI measurement

Context

RSSI signal measurement is the main Rx troubleshooting measurement. The test measures the strength of the received signal.

I and Q branches can be measured separately. In GSM, the input signal can be either a real GSM signal or a CW (Continuous Wave) signal that is 67.771 kHz above the carrier frequency.

Steps

1. Start *Phoenix* service software.
2. Choose **Testing→GSM→RSSI Reading** .
3. Set the RF signal generator for a channel frequency +67.771 kHz in CW mode with a –80 dBm signal level.

   Alternatively set the cellular tester downlink channel to the appropriate channel. Make sure that the tester is set to continuous mode, not to burst mode.
4. In the *RSSI Reading* window, select the appropriate band and channel.

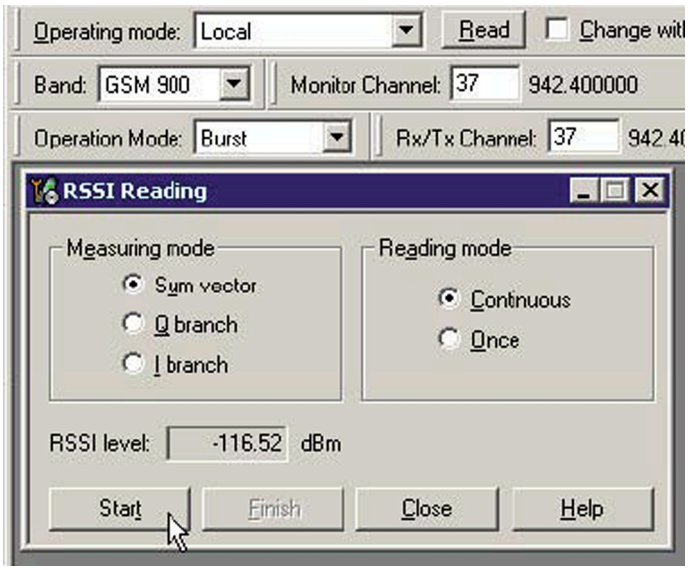

Figure 17 *RSSI Reading* window

5. To start the measurement, activate GSM Rx chain, click **Start**.

Results

RSSI reading values of the selected band and channel are displayed. The RSSI level must be the same value as that which is set at the signal generator (-80 dBm).

Transmitter troubleshooting

General instructions for TX troubleshooting

Context

- Tx troubleshooting requires Tx operation.
- Do not transmit on frequencies that are in use!
- Transmitter can be controlled in the local mode for diagnostic purposes.
- The most useful Phoenix tool for GSM transmitter testing is "RF Controls".

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- Tx IQ tuning and Tx power tuning can be also used in some cases.
- Remember that retuning is not a fix! Phones are tuned correctly in production.

The first set of steps instructs how to assemble the test setup. This setup is general for all Tx troubleshooting tasks.

Alternative steps provide specific troubleshooting instructions for *Phoenix* service software.

> **Caution:** Never activate the GSM transmitter without a proper antenna load. There should be always 50 Ω load connected to the RF connector (antenna, RF-measurement equipment or at least 2 W dummy load), otherwise the GSM Power amplifier may be damaged.

Steps

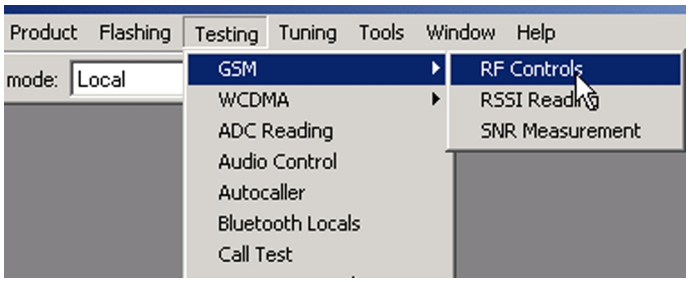
1. Connect a test jig to a computer with a DAU-9S cable or to a FPS-10 flash prommer with a modular cable (XCS-4).

   Make sure that you have a PKD-1 dongle connected to the computer's parallel port.
2. Connect CU-4 with 12 V supply. The DC supply voltage is set to 3.7 V by default (in Phoenix).
3. Connect an RF cable between the RF connector of the module test jig (MJ-156) and measurement equipment or alternatively use a 50 Ω (at least 2 W) dummy load in the module test jig RF connector, otherwise GSM may be damaged.

   > **Note:** There are two antenna connectors in the module jig:
   > - one for GSM
   > - one for Bluetooth
   >
   > Make sure that all connections are made to the correct RF connector.

   Normally a spectrum analyser is used as measurement equipment.

   > **Note:** The maximum input power of a spectrum analyser is +30 dBm.
   >
   > To prevent any damage, it is recommended to use 10 dB attenuator on the spectrum analyzer input.
4. Set Tx on.
   i Set the phone module to the test jig and start *Phoenix service software*.
   ii Initialize connection to the phone. (With the FPS-10 prommer use FPS10_USB or FPS10_TCP drivers, depending on connection type. When using DAU-9S select FBUS driver).
   iii From the File menu, choose product: **File -> Choose Product -> xx-x*** (* = type designator of the phone, e.g. RM-322/323), or press**Ctrl + R** to scan product.
   iv From the toolbar, set operating mode to “Local”.
5. GSM850/900/1800/1900 troubleshooting
   i From the Testing menu, activate the *RF Controls* window: **Testing -> GSM -> RF Controls** .



   ii In the *RF Controls* window:
   - Select band "GSM850", “GSM900” or “GSM1800” or “GSM1900”.
   - Set Active unit to “Tx” (Default = “Rx”).

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- Set Operation mode to “Burst” (Default).
- Set Tx data type to “All1” (Default).
- Set Rx/Tx channel (see table below)
- Set Edge to “Off” (Default).
- Set Tx PA mode to “High” (Default).
- Set power level (see table below)

Band	Channel (RX and TX)	TX power level
GSM850	190	5
GSM900	37	5
GSM1800	700	0
GSM1900	661	0

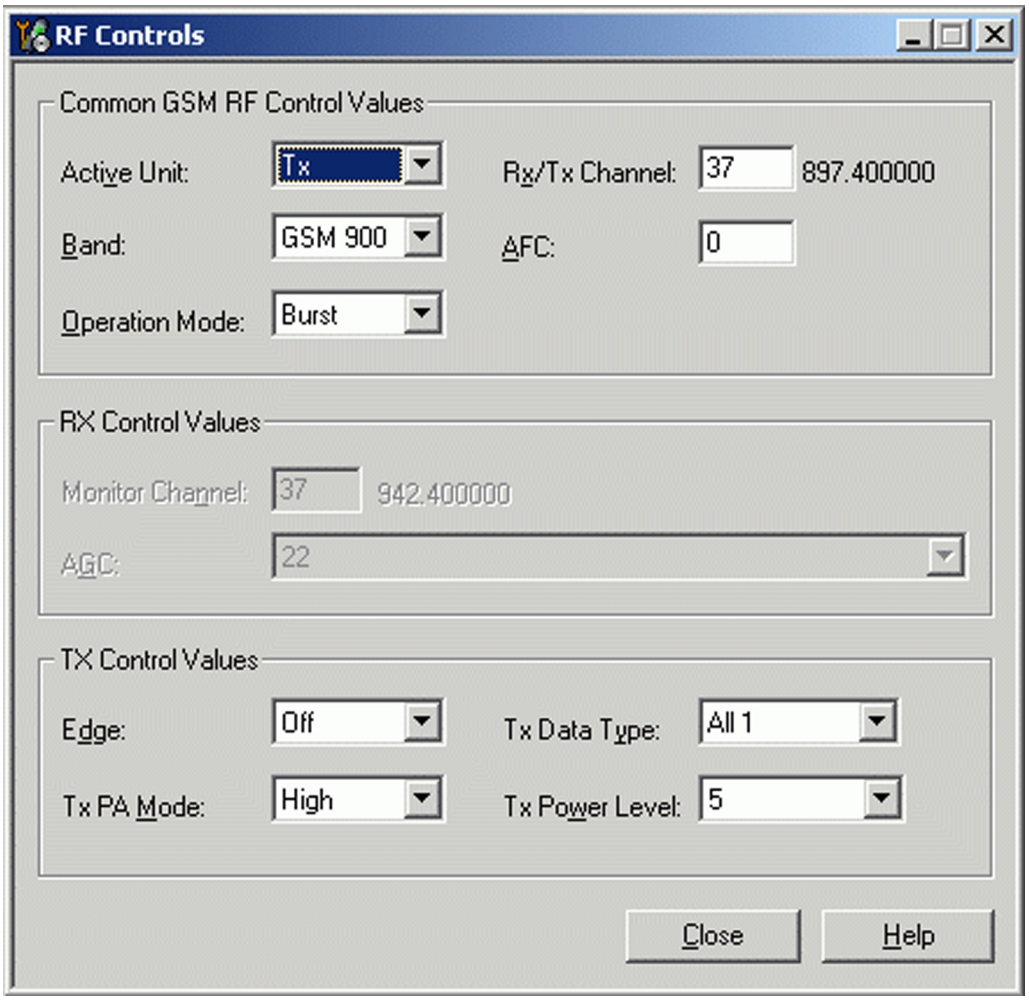

Figure 18 RF Controls window

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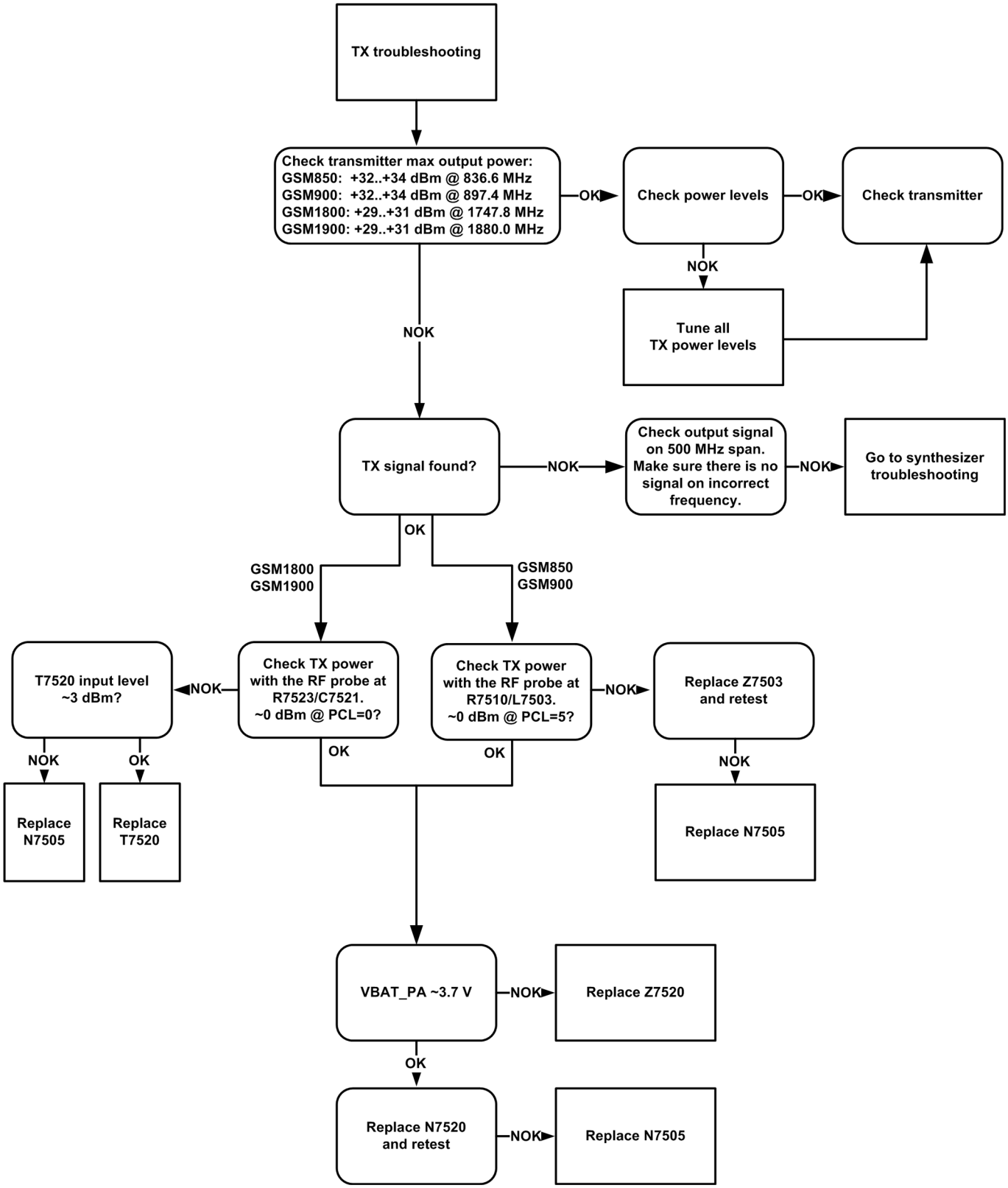
Transceiver (TX) troubleshooting

Troubleshooting flow



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Checking antenna functionality

GSM antenna

In the GSM antenna, there is one feed and two GND contacts.

Between GND1 and Feed, a DC short-circuit can be measured.

GND2 has no DC connection to the other contacts.

The antenna is functioning normally, if the contact pads hit the antenna C-clips on the PWB and the antenna is visually intact.

BT/WLAN antenna

The BT/WLAN antenna is (as the GSM antenna) placed on the flex foil on the antenna module. It has one feed and one short contact. The antenna is functioning normally, if the contact pads hit the antenna C-clips on the PWB and the antenna is visually intact.

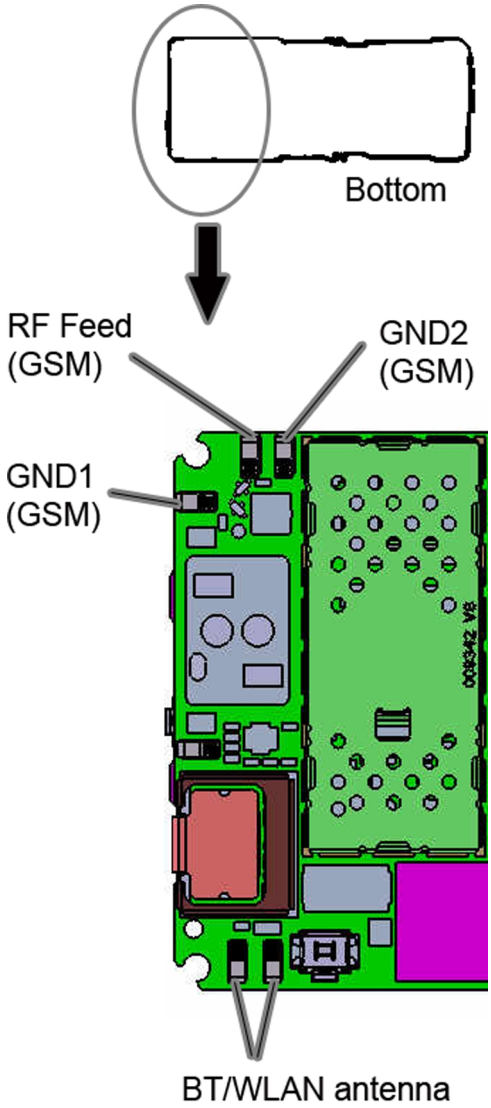

Figure 19 Location of the GSM and BT/WLAN antenna C-clips on the PWB

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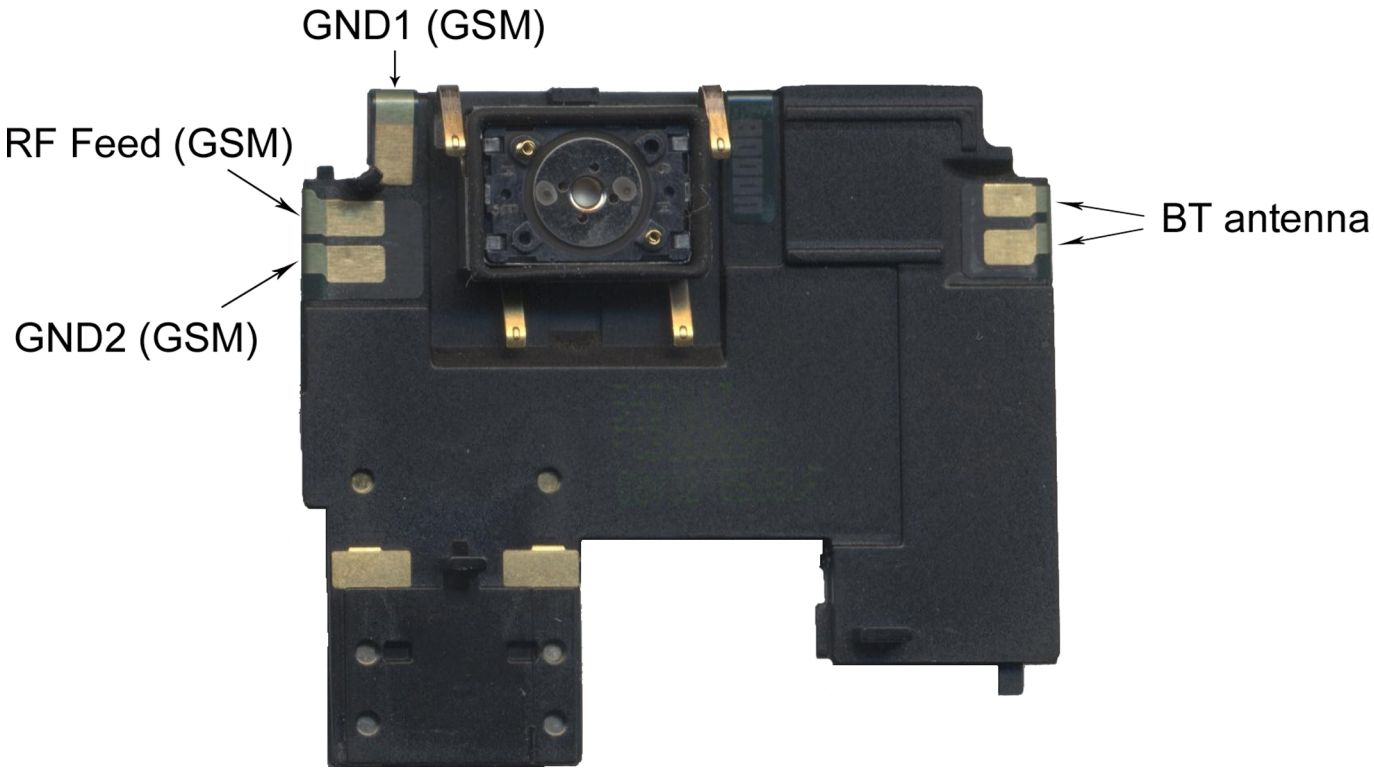

Figure 20 GSM and BT/WLAN antenna contact pads on the antenna module

Antenna C-clips

When checking the antenna functionality, you can also check that the antenna C-clips are intact (that is, there are no cracks/bends in them).

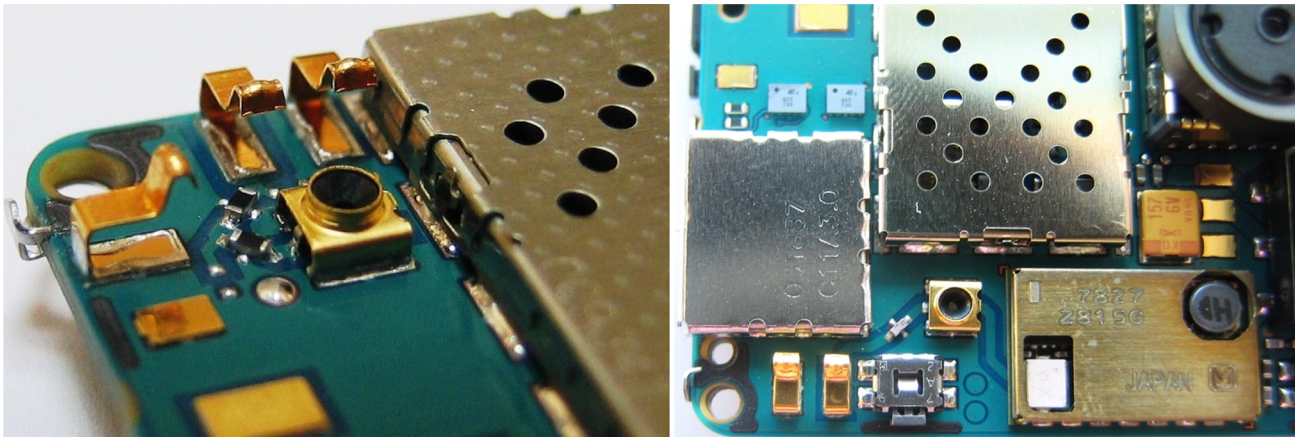

Figure 21 Antenna C-clips on the PWB

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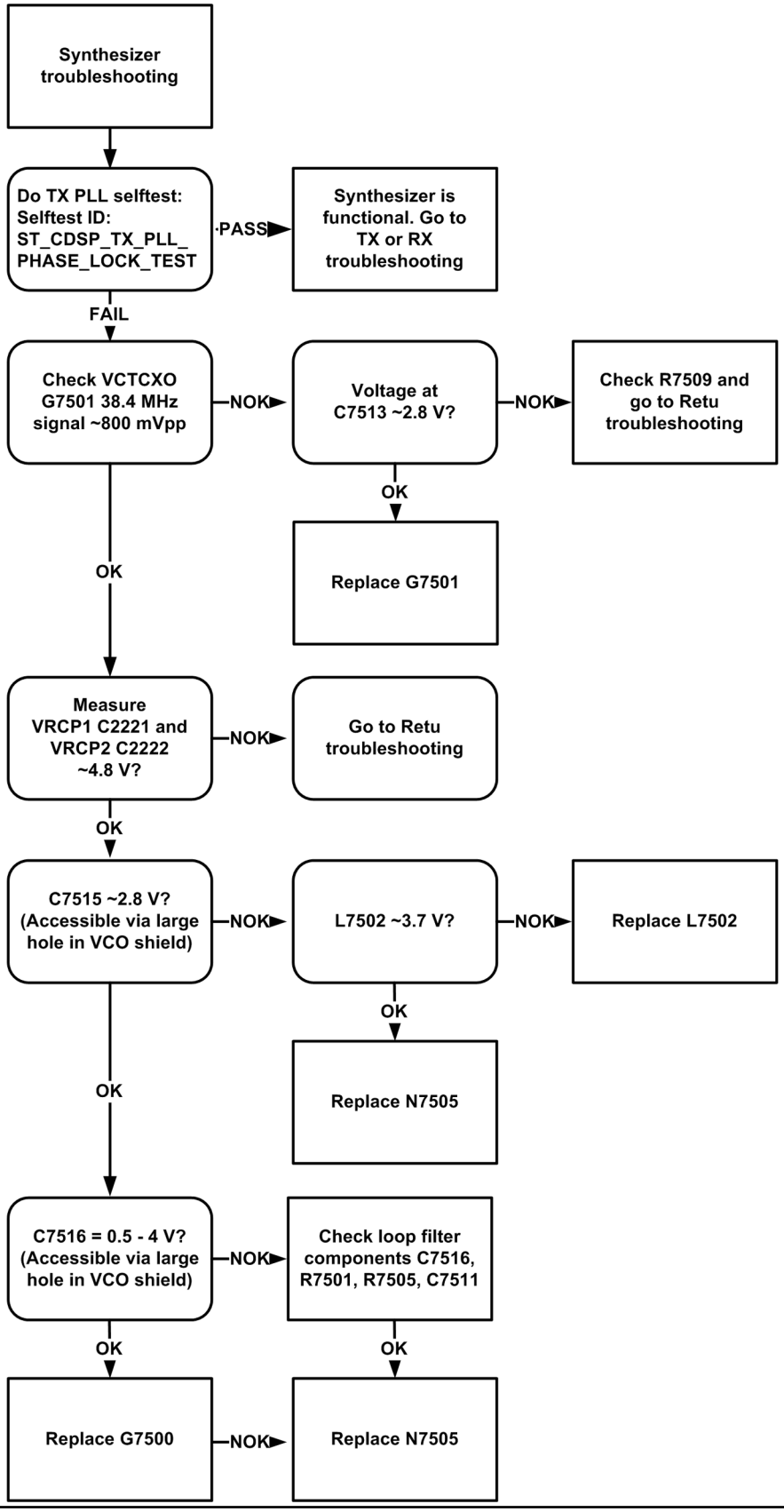
Synthesizer troubleshooting

Synthesizer troubleshooting



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RF tunings

Introduction to RF tunings

Important: Only perform RF tunings if:

- one or more of the RF components have been replaced
- flash memory chip is replaced or corrupted.

RF calibration is always performed with the help of a product-specific module jig (MJ-156), never with an RF coupler. Using an RF coupler in the calibration phase will cause a complete mistuning of the RF part.

Important: After RF component replacements, **always** use autotuning. Manual tunings are only required in rare cases.

Cable and adapter losses

RF cables and adapters have some losses. They have to be taken into account when the phone is tuned. As all RF losses are frequency dependent, the user has to act very carefully and understand the measurement setup.

For RF attenuations of the module jig, please refer to the Service tools section.

Auto tuning for BB5.0

This phone can be tuned automatically.

Autotune is designed to align the phone's RF part easier and faster. It performs calibrations, tunings and measurements of RX and TX. The results are displayed and logged in a result file, if initiated.

Hardware set up

Hardware requirements for auto tuning:

- PC (Windows 2000/XP) with GPIB card
- Power supply
- Product specific module jig
- Cables: XRF-1 (RF cable), USB cable, GBIP cable and DAU-9S
- Signal analyser (TX), signal generator (RX) and RF-splitter *or* one device including all.

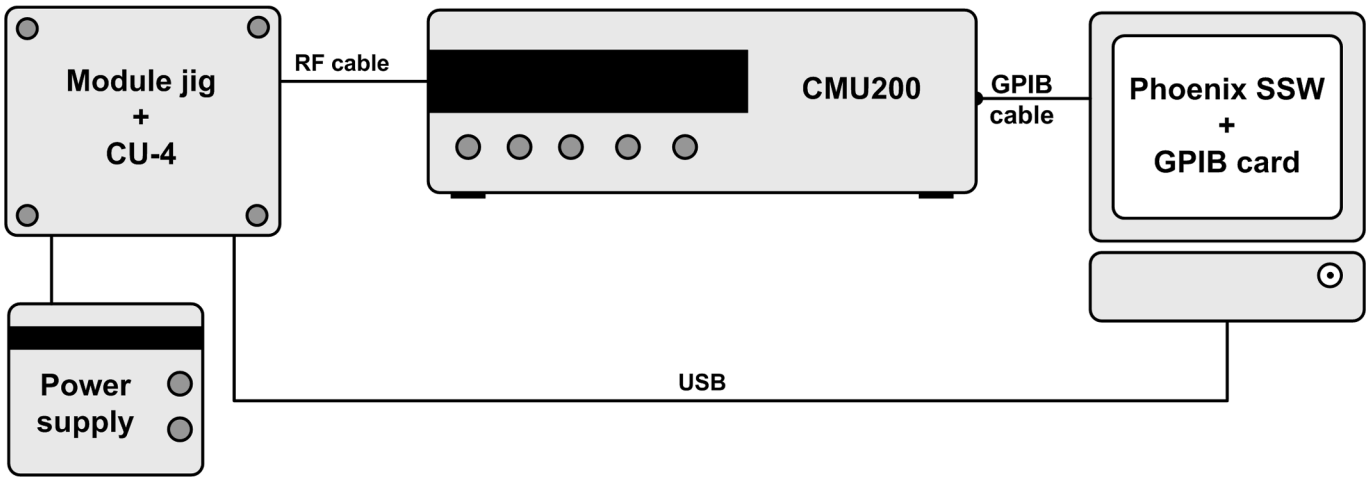

Figure 22 Auto tuning concept with CMU200

Note: Crossover Cable connection between computer and CU200 is recommended (refer to Service Devices chapter and Module Jig concept).

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Phoenix preparations

Install the phone specific data package, for example *RM-322/323_dp_1.78_sw_sh3.26.exe*. This defines phone specific settings..

Auto tuning procedure

1 Make sure the phone (in the jig) is connected to the equipment. Else, some menus will not be shown in Phoenix.

2 To go to autotune, select *Tuning (Alt-U)* > *Auto-Tune (Alt-A)* from the menu.

3 Start autotuning, clicking the *Tune* button.

System mode independent manual tunings

RF channel filter calibration

Context

Rf channel filter calibration tunes the internal low pass filters of the RF ASIC, that limit the bandwidth of BB IQ signals.

Table 9 Rf channel filter calibration tuning limits

	Min	Typ	Max
Tx filter	0	10	31
RX mixer	0	13	31
Rx filter	0	16	31

Steps

1. From the **Operating mode** drop-down menu, set mode to **Local**.
2. Choose **Tuning→Rf Channel Filter Calibration** .
3. Click **Tune**.
4. To save the values to the PMM (Phone Permanent Memory) area, click **Write**.
5. To close the *Rf Channel Filter Calibration* window, click **Close**.

Results

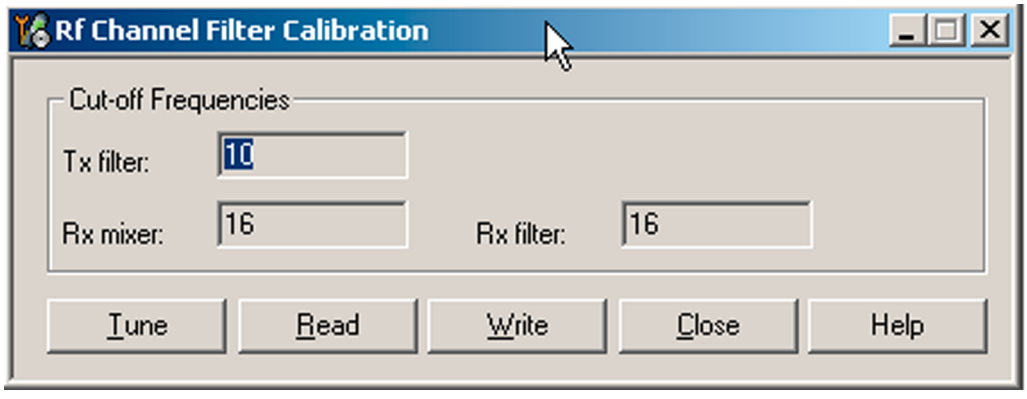

Figure 23 Rf channel filter calibration typical values

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PA (power amplifier) detection

Context

The PA detection procedure detects which PA manufacturer is used for phone PAs.

If a PA is changed or if the permanent memory (PMM) data is corrupted, PA detection has to be performed before Tx tunings.

Steps

1. From the **Operating mode** drop-down menu, set mode to **Local**.
2. Choose **Tuning→PA Detection** .
3. Click **Tune**.
4. Check that the detected PA manufacturers are corresponding to the actual chips on the board.
5. To end the procedure, click **Close**.

GSM receiver tunings

Rx calibration (GSM)

Context

Rx Calibration is used to find out the real gain values of the GSM Rx AGC system and tuning response of the AFC system (AFC D/A init value and AFC slope)

Steps

1. Connect the GSM connector of the module jig to a signal generator.
2. Start *Phoenix* service software.
3. From the **Operating mode** drop-down menu, set mode to **Local**.
4. Choose **Tuning→GSM→Rx Calibration** .

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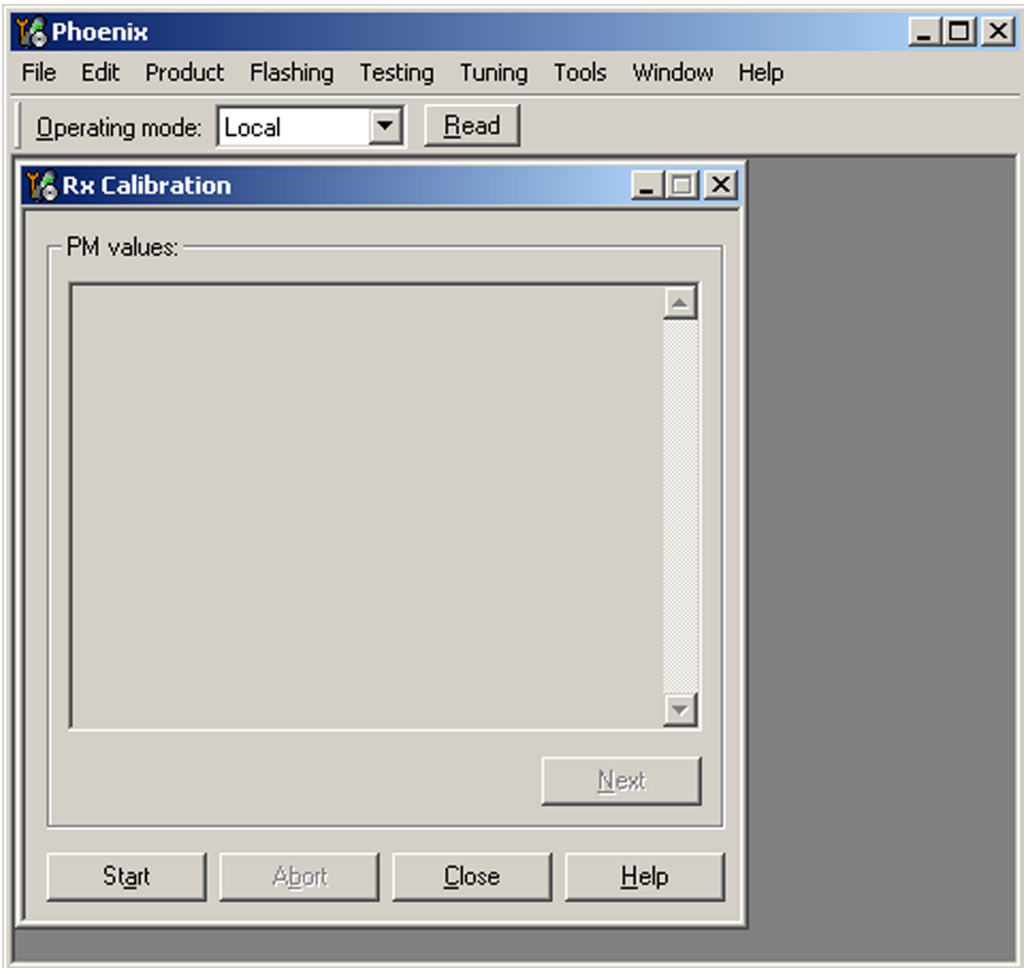
5. Click **Start**.



6. Connect the signal generator to the phone, and set frequency and amplitude as instructed in the **Rx Calibration with band EGSM900** (step 1-3) pop-up window.

   Important: The calibration uses a non-modulated CW signal. Increase the signal generator level by cable attenuation and module jig probe attenuation.

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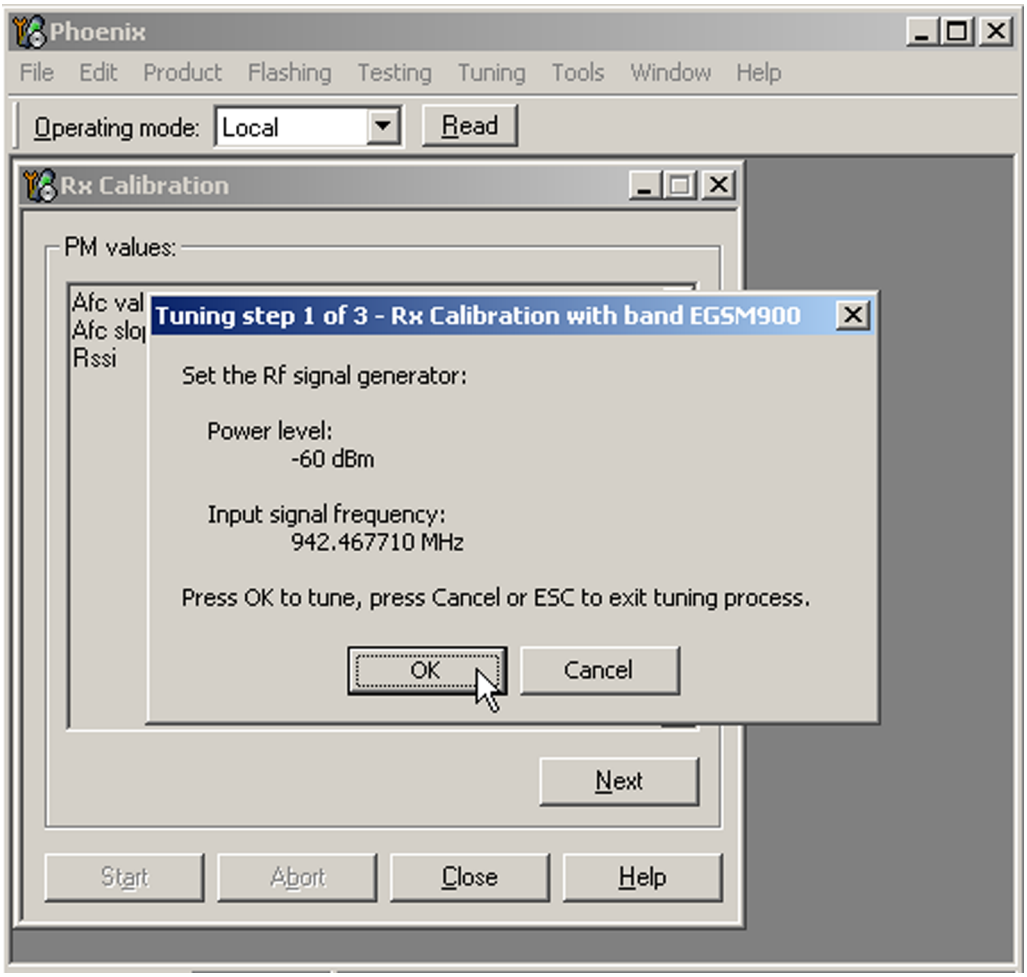

7. To perform the tuning, click **OK**.
8. Check that the tuning values are within the limits specified in the following table:

Table 10 RF tuning limits in Rx calibration

	Min	Typ	Max	Unit
GSM850				
AFC Value (init)	-200	-80..40	200	-
AFC slope	0	108..121	200	-
RSSI (AGC-0)	106	107..110	114	dB
GSM900				
AFC Value (init)	-200	-105..62	200	-
AFC slope	0	122	200	-
RSSI (AGC-0)	106	107...110	114	dB
GSM1800				
RSSI (AGC-0)	105	105...109	114	dB
GSM1900				
RSSI (AGC-0)	105	105...109	114	dB

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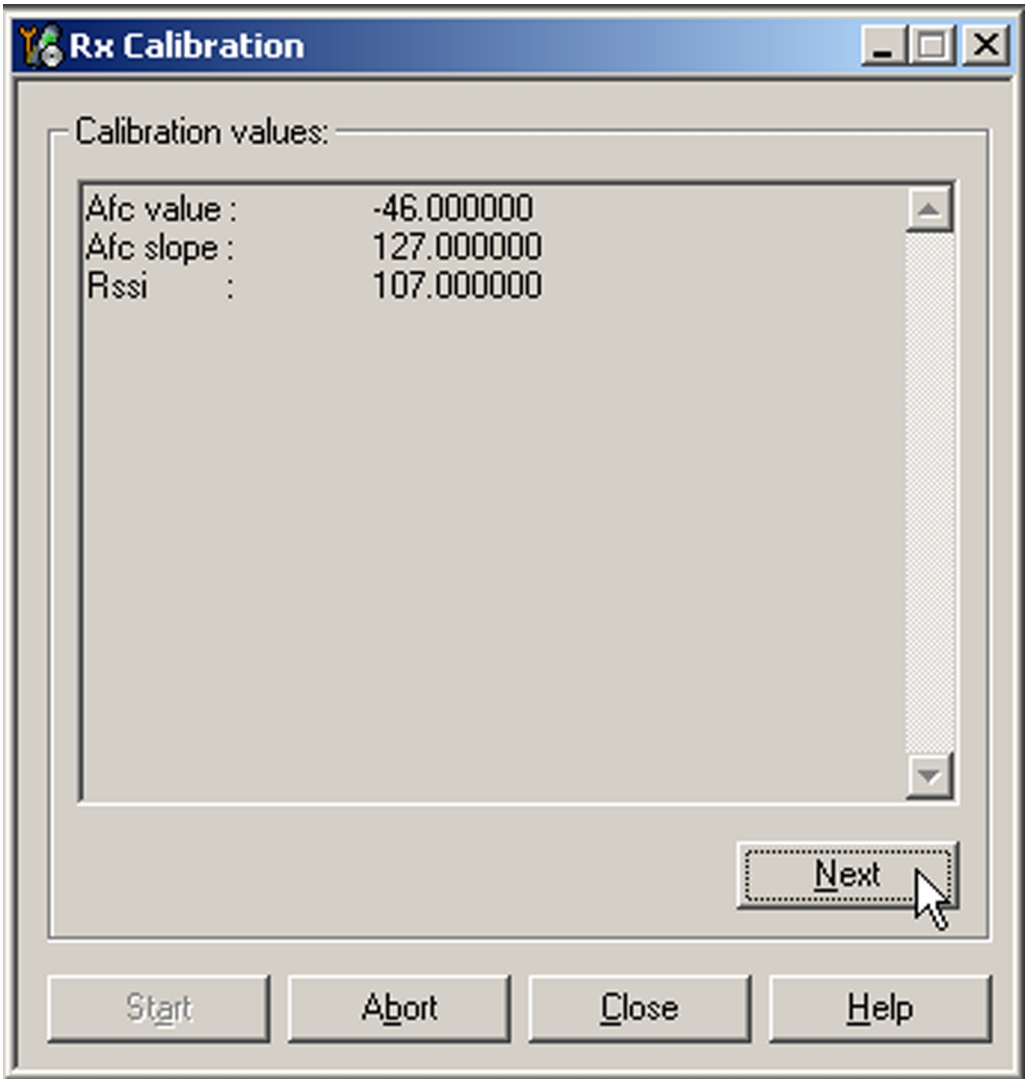
9. Click **Next** to continue with GSM1800 Rx tuning.



Next actions

Repeat steps 6 to 9 for GSM1800 and GSM1900

Rx band filter response compensation (GSM)

Prerequisites

Rx calibration must be performed before the Rx band filter response compensation.

Context

On each GSM Rx band, there is a band filter in front of the RF ASIC front end. The amplitude ripple caused by these filters causes ripple to the RSSI measurement, and therefore calibration is needed.

The calibration has to be repeated for each GSM band.

Steps

1. Connect the GSM connector of the module jig to a signal generator.
2. Start *Phoenix* service software.
3. From the **Operating mode** drop-down menu, set mode to **Local**.

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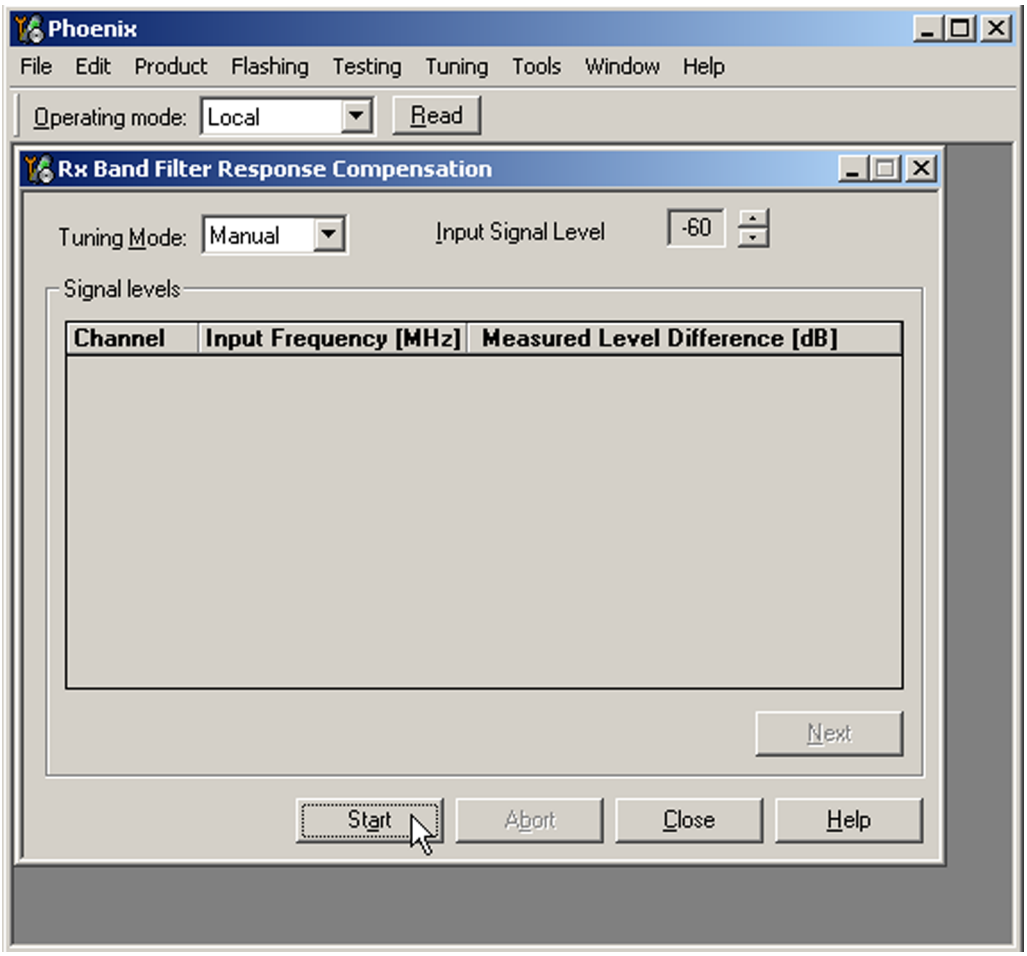
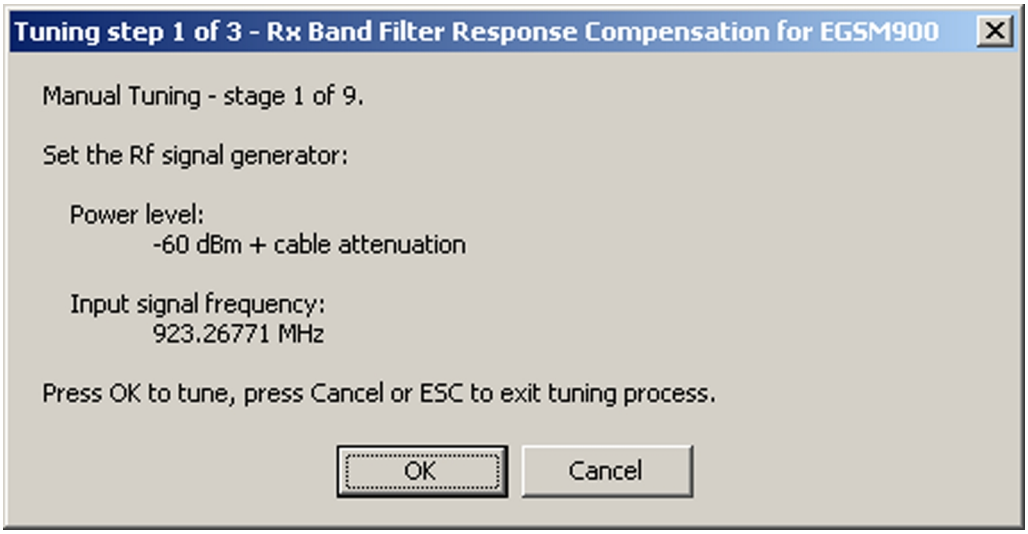
4. Select **GSM850** or **GSM900** band.
5. Choose **Tuning→GSM→Rx Band Filter Response Compensation** .
6. Select **Tuning mode: manual**
7. Click **Start**.



8. Connect the signal generator to the phone, and set frequency and amplitude as instructed in the *Rx Band Filter Response Compensation for EGSM850/EGSM900* pop-up window, step 1-3.



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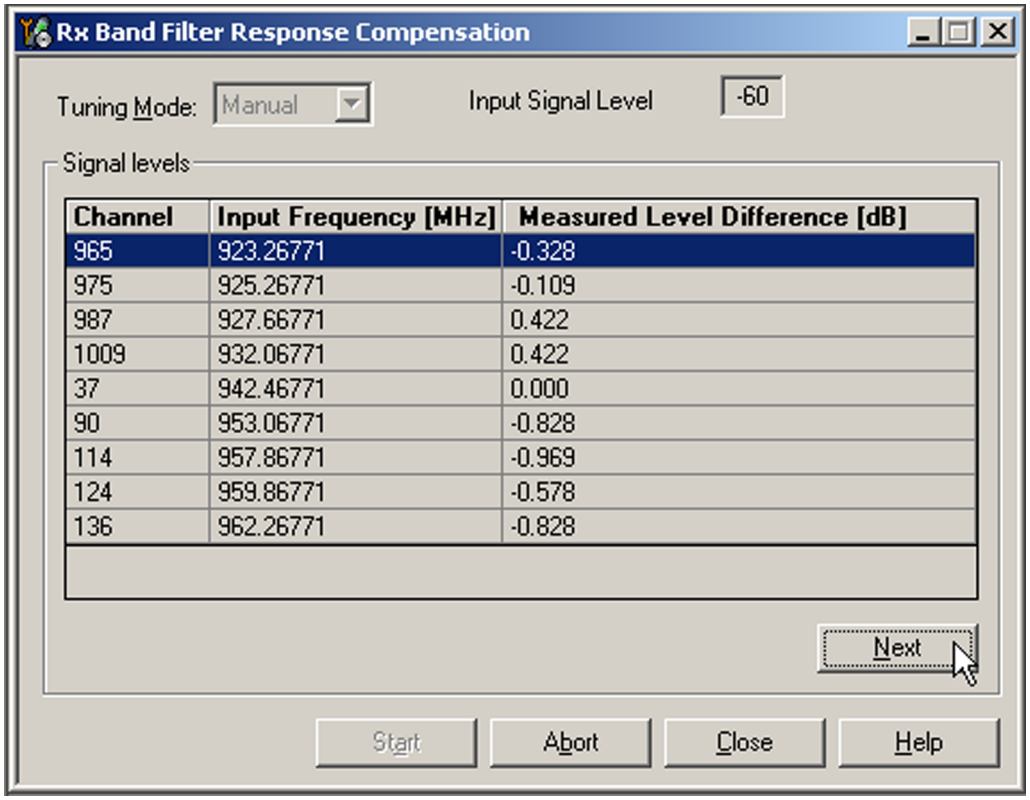
9. To perform tuning, click **OK**.
10. Go through all 9 frequencies. The following table will be shown:



11. Check that the tuning values are within the limits specified in the following table:

	Min	Typ	Max	Unit
GSM850				
Ch. 118/867.26771 MHz	-6	-1	2	dB
Ch. 128/869.26771 MHz	-3	0	2	dB
Ch. 140/871.66771 MHz	-3	0	2	dB
Ch. 172/878.06771 MHz	-2	0	2	dB
Ch. 190/881.66771 MHz	-2	0	2	dB
Ch. 217 / 887.06771 MHz	-2	0	2	dB
Ch. 241/891.86771 MHz	-3	0	2	dB
Ch. 251/893.86771 MHz	-3	0	2	dB
Ch. 261/895.86771 MHz	-6	-1	-2	dB
GSM900				
Ch. 965 / 923.26771 MHz	-6	-1	2	dB
Ch. 975 / 925.26771 MHz	-3	0	2	dB
Ch. 987 / 927.66771 MHz	-3	0	2	dB
Ch. 1009 / 932.06771 MHz	-2	0	2	dB

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	Min	Typ	Max	Unit
Ch. 37 / 942.46771 MHz	-2	0	2	dB
Ch. 90 / 953.06771 MHz	-2	0	2	dB
Ch. 114 / 957.86771 MHz	-3	0	2	dB
Ch. 124 / 959.86771 MHz	-3	0	2	dB
Ch. 136 / 962.26771 MHz	-6	-1	2	dB
GSM1800				
Ch. 497 / 1802.26771 MHz	-6	-1	3	dB
Ch. 512 / 1805.26771 MHz	-3	0	3	dB
Ch. 535 / 1809.86771 MHz	-3	0	3	dB
Ch. 606 / 1824.06771 MHz	-3	0	3	dB
Ch. 700 / 1842.86771 MHz	-3	0	3	dB
Ch. 791 / 1861.06771 MHz	-3	0	3	dB
Ch. 870 / 1876.86771 MHz	-3	0	3	dB
Ch. 885 / 1879.86771 MHz	-3	0	3	dB
Ch. 908 / 1884.46771 MHz	-6	-1	3	dB
GSM1900				
Ch. 496 / 1927.06771 MHz	-6	-1	2	dB
Ch. 512 / 1930.26771 MHz	-3	0	2	dB
Ch. 537 / 1935.26771 MHz	-3	0	2	dB
Ch. 586 / 1945.06771 MHz	-3	0	2	dB
Ch. 661 / 1960.06771 MHz	-3	0	2	dB
Ch. 736 / 1975.06771 MHz	-3	0	2	dB
Ch. 794 / 1986.66771 MHz	-3	0	2	dB
Ch. 810 / 1989.86771 MHz	-3	0	2	dB
Ch. 835 / 1994.86771 MHz	-6	-1	2	dB

12. If the values are within the limits, click **Next** to continue to the next band.

Next actions

Repeat the steps 8 to 12 for GSM1800 and GSM1900.

GSM transmitter tunings

Tx IQ tuning (GSM)

Context

The Tx path branches to I and Q signals at RF I/Q modulator. Modulator and analog hardware located after it cause unequal amplitude and phase disturbance to I and Q signal paths. Tx IQ tuning balances the I and Q branches.

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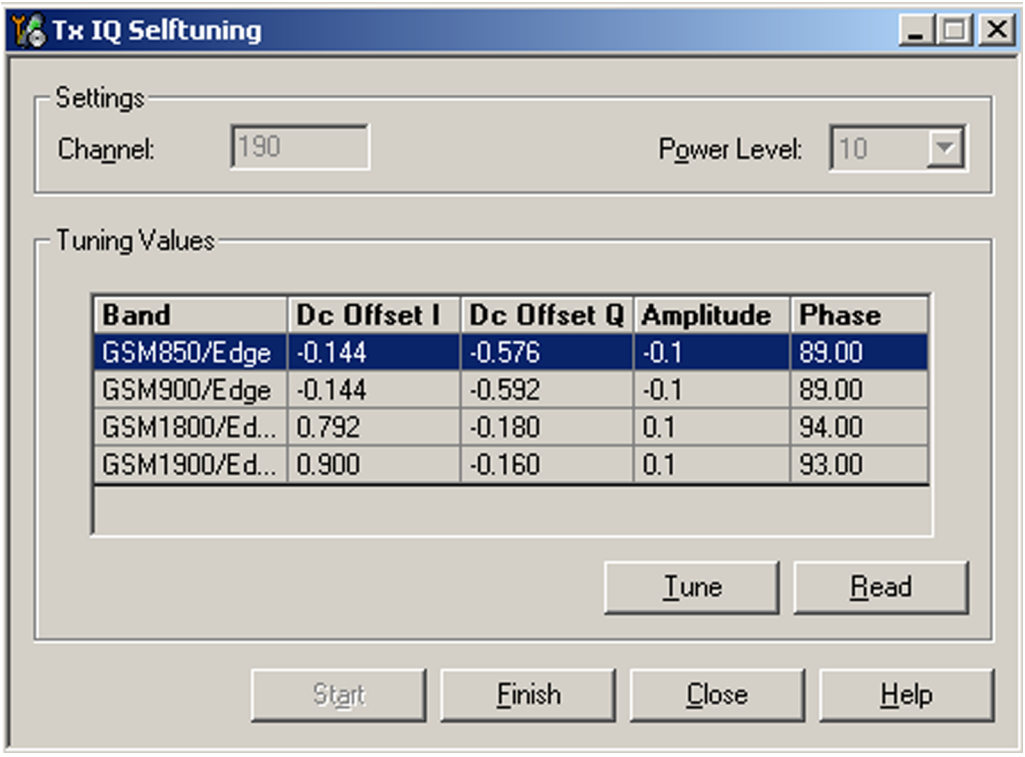
Tx IQ tuning must be performed for all GSM bands.

Steps

1. Start *Phoenix* service software.
2. From the **Operating mode** drop-down menu, set mode to **Local**.
3. Choose **Tuning→GSM→Tx IQ Tuning** .
4. Select **Mode: Automatic**.



5. Select band **GSM850** or **GSM900** and click **Start**.
6. Click **Next** to start GSM1800 band TX IQ tuning.
7. Click **Next** to start GSM1900 band TX IQ tuning.
8. Click**Finish** and then **Close**.

Next actions

Tuning sliders should be close to the center of the scale after the tuning and within the limits specified in the following table. If they are not within the limits, check Tx IQ quality manually.

	Min	Typ	Max	Unit
GSM850				
I DC offset / Q DC offset	-6	-4	6	%
Ampl	-1	0	1	dB
Phase	85	90	95	°
GSM900				

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	Min	Typ	Max	Unit
I DC offset / Q DC offset	-6	-4	6	%
Ampl	-1	0	1	dB
Phase	85	90	95	°
GSM1800/GSM1900				
I/Q DC	-6	0.5	6	%
Ampl	-1	0	1	dB
Phase	95	100	110	°

Tx power level tuning (GSM)

Context

Because of variations at the IC (Integrated Circuit) process and discrete component values, the actual transmitter RF gain of each phone is different. Tx power level tuning is used to find out mapping factors called 'power coefficients'. These adjust the GSM transmitter output power to fulfill the specifications.

For EDGE transmission, the bias settings of the GSM PA are adjusted in order to improve linearity. This affects the PA gain and hence the power levels have to be aligned separately for EDGE transmission.

Tx power level tuning has to be performed on all GSM bands.

Steps

1. Connect the phone to a spectrum analyzer.
2. Start *Phoenix* service software.
3. From the **Operating mode** drop-down menu, set mode to **Local**.
4. Choose **Tuning→GSM→Tx Power Level Tuning** .

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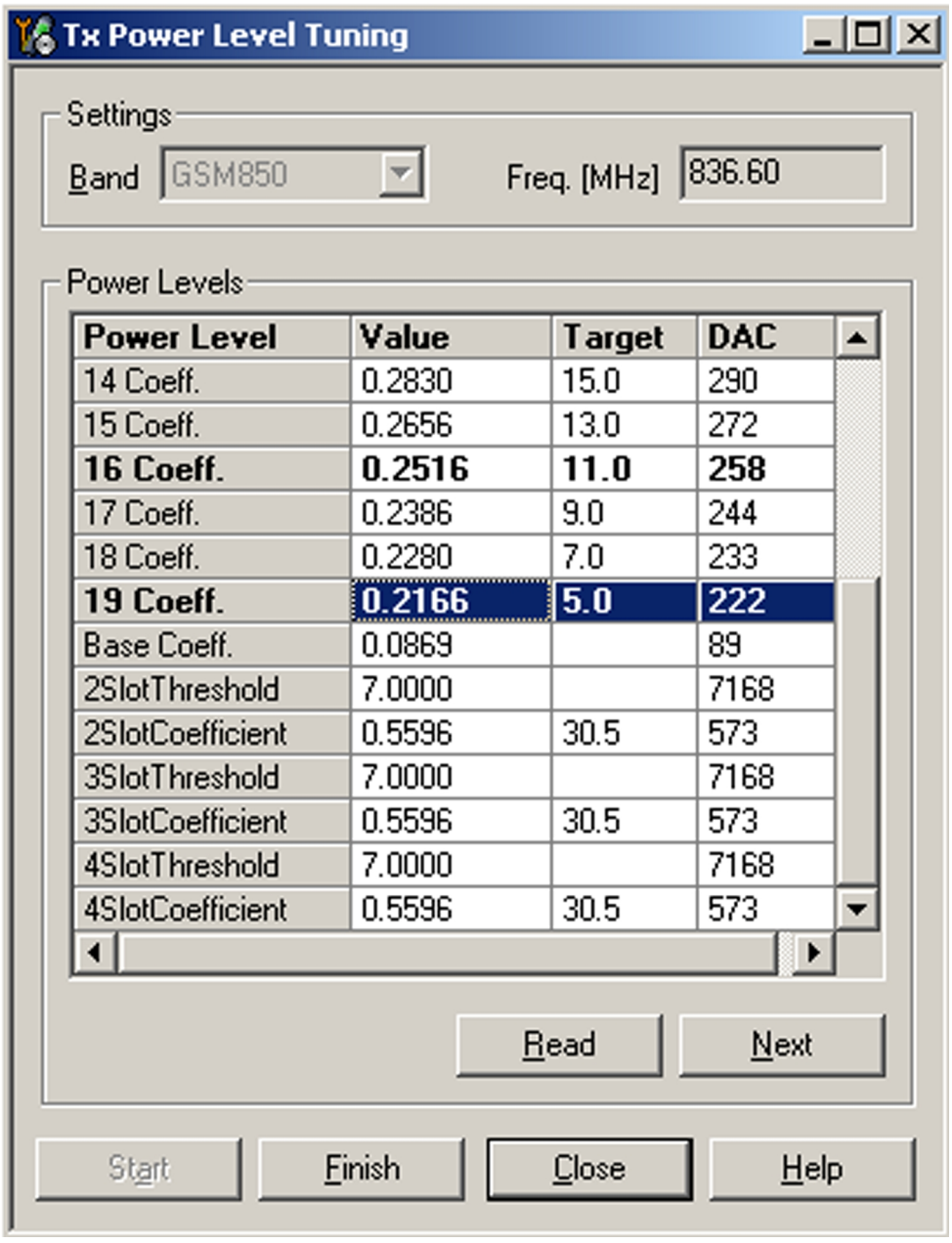
5. Click **Start**.l



6. Set the spectrum analyzer for power level tuning:

Frequency	Channel frequency: • **836.6 MHz GSM850** • **897.4MHz GSM900** • **1747.8MHz GSM1800** • **1880MHz GSM1900**
Span	0 Hz
Sweep time	2ms
Trigger	Video triggering (-10dBm)

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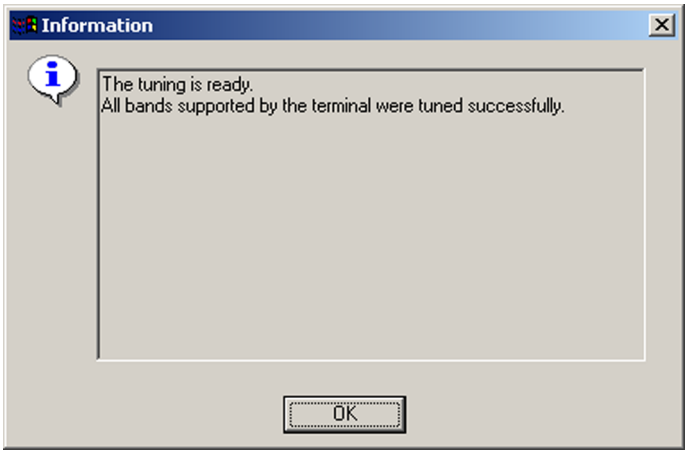
Resolution BW	3MHz
Video BW	3MHz
Reference level offset	sum cable attenuation with module jig attenuation
Reference level	33dBm

A power meter with a peak power detector can be also used. Remember to take the attenuations into account.

7. Adjust power for all bold power levels to correspond the **Target dBm** column by pressing **+** or **–** keys.
8. If all bold power levels are adjusted, click **Next** to continue with **GSM850 EDGE**.
9. Adjust power for all bold power levels to correspond the **Target dBm** column by pressing **+** or **–** keys.

Next actions

Continue tuning the bold power levels of the GSM900, GSM1800 and GSM1900 bands. You will see this message, if finished successfully:



Bluetooth and FM radio troubleshooting

Introduction to Bluetooth and FM troubleshooting

Introduction

The Bluetooth and FM radio are combined in the same ASIC, so both features are checked when troubleshooting.

The following problems can occur with the Bluetooth and FM radio hardware:

Symptom	Problem	Repair solution
Unable to switch on Bluetooth on phone user interface.	Open circuit solder joints or component failure of BTH/FM ASIC/module BB ASICs or SMD components.	Replacement of Bluetooth/FM ASIC/module
Able to send data file to another Bluetooth device, but unable to hear audio through functional Bluetooth headset.	Open circuit solder joints or component failure of BTH/FM ASIC/module BB ASICs (PCM interface).	Replacement of Bluetooth/FM ASIC/module

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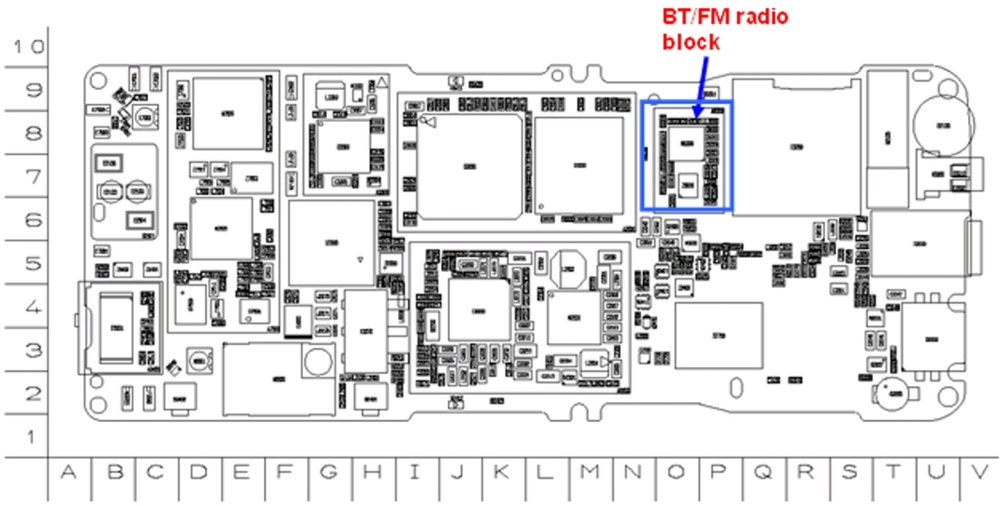
Symptom	Problem	Repair solution
Able to turn switch on Bluetooth on phone user interface, but unable to detect other Bluetooth devices.	Open circuit solder joints or detacted component in Bluetooth antenna circuit.	Repair of Bluetooth antenna circuit
Able to turn on FM radio and Bluetooth on phone user interface, but unable to detect local FM radio stations with FM headset inserted.	Open circuit solder joints or detached component in FM antenna circuit.	Repair of FM antenna circuit
Able to perform scans to detect local FM radio stations with functional FM headset inserted, but unable to hear FM audio through headset.	Open circuit solder joints or detached component in FM audio path between Bluetooth/FM ASIC and headset.	Repair of FM audio circuit

Bluetooth and FM Radio component placement



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Test points in Bluetooth-FM ASIC circuit

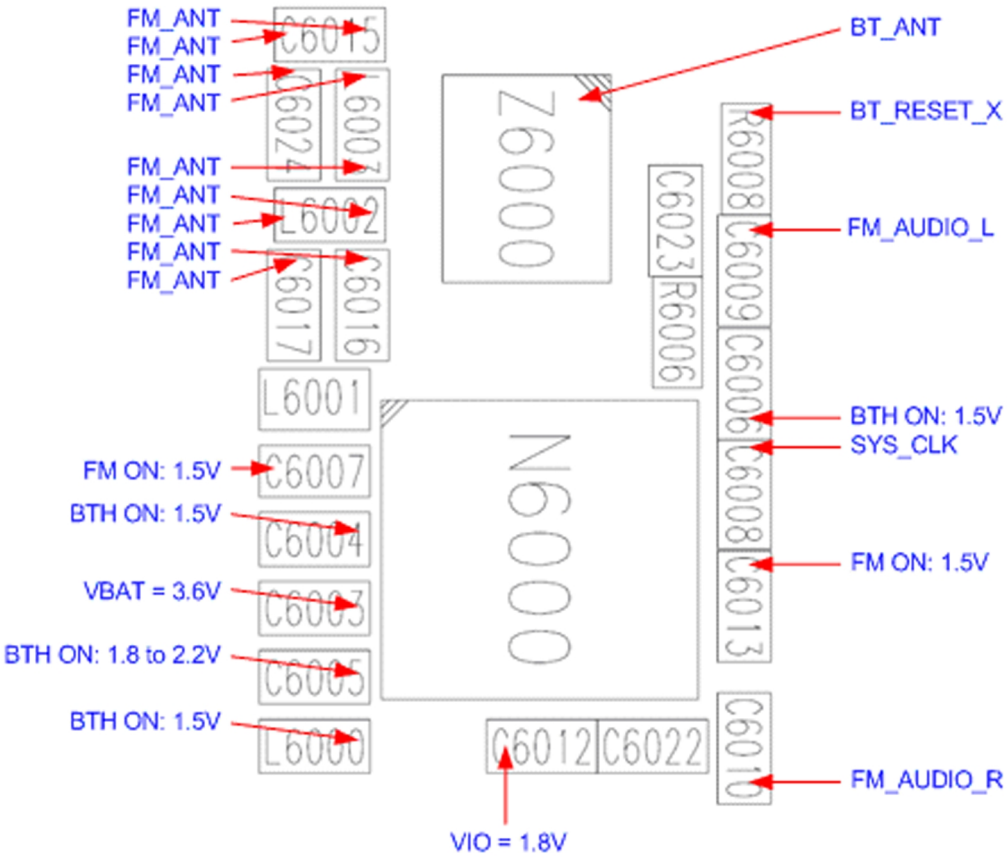

Figure 24 Test points for BTHFMRDS2.0D

The Bluetooth RF signal is routed through a WLAN front-end module and a shared Bluetooth / WLAN antenna is used.

The FM RF signal is routed through a product specific FM antenna matching circuit to the phone headset connector. Typically, the FM antenna matching circuit is located near to the phone headset connector.

The FM radio audio signal is routed to the headset connector through the BB ASIC shared by the phone audio functions.

Bluetooth and FM radio self tests

Context

A flash adapter (or phone data cable) connected to a PC with Phoenix service software is required.

Steps

1. Place the phone in the flash adapter.
2. Start *Pheonix*service software.
3. Choose **FileScan Product**.
4. From the mode drop-down menu, set to **Local**.
5. Choose **Testing Self Tests** .
6. In the Self Tests window check the following Bluetooth and FM Radio tests:
   - ST_LPRF_IF_TEST

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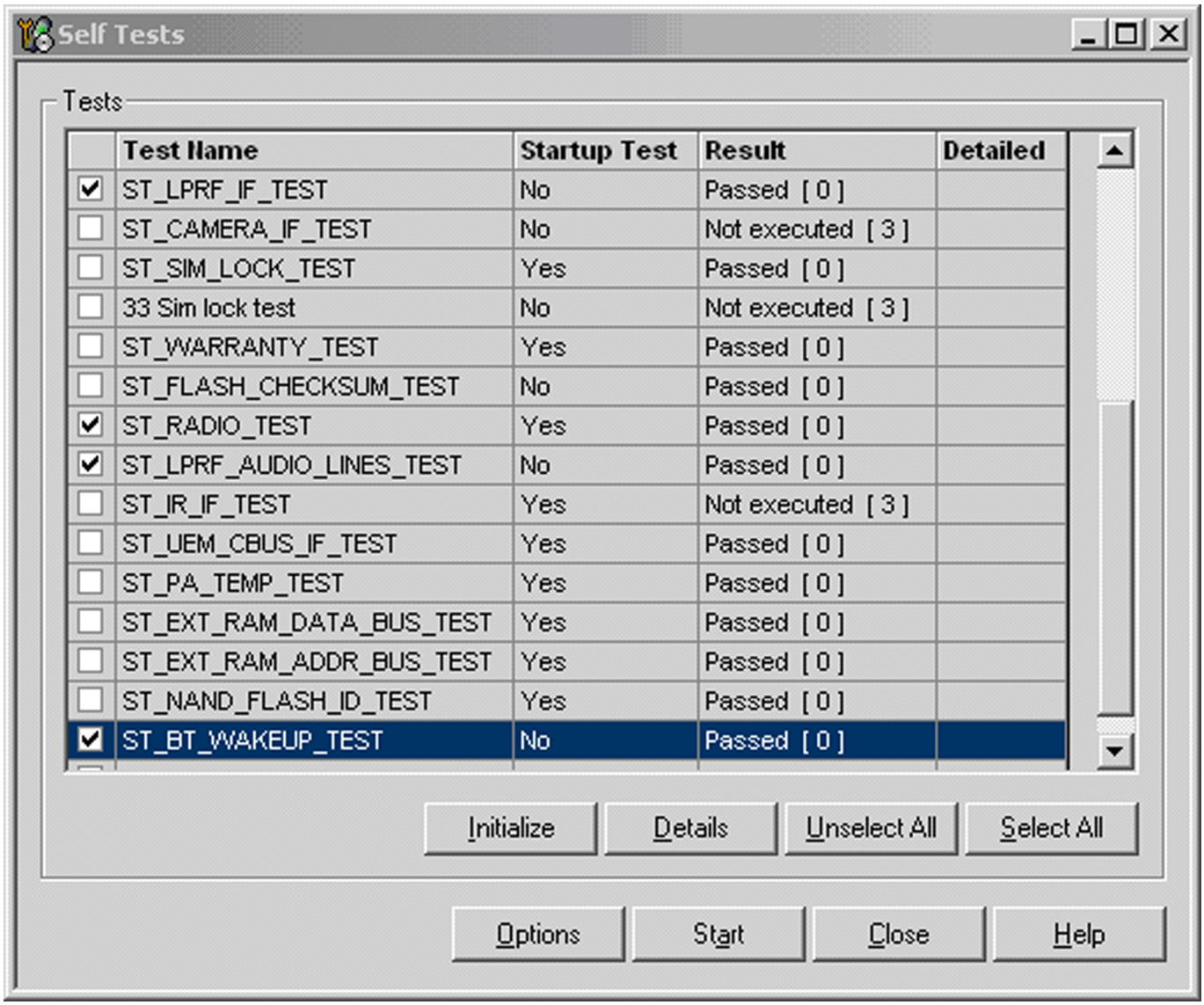
- ST_LPRF_AUDIO_LINES_TEST
- ST_BT_WAKEUP_TEST
- ST_RADIO_TEST

7. To run the test, click **Start**



Bluetooth BER Test

Context

JBT-9, or SB-6 Bluetooth test box (BT-box) is required to perform a BER test. If a BT-box if not available Bluetooth functionality can be checked by transferring a file to another Bluetooth phone.

Steps

1. Place the phone in the flash adapter.
2. Start *Phoenix* service software.
3. Choose **File Scan Product** .
4. Choose **Testing Bluetooth LOCALS**

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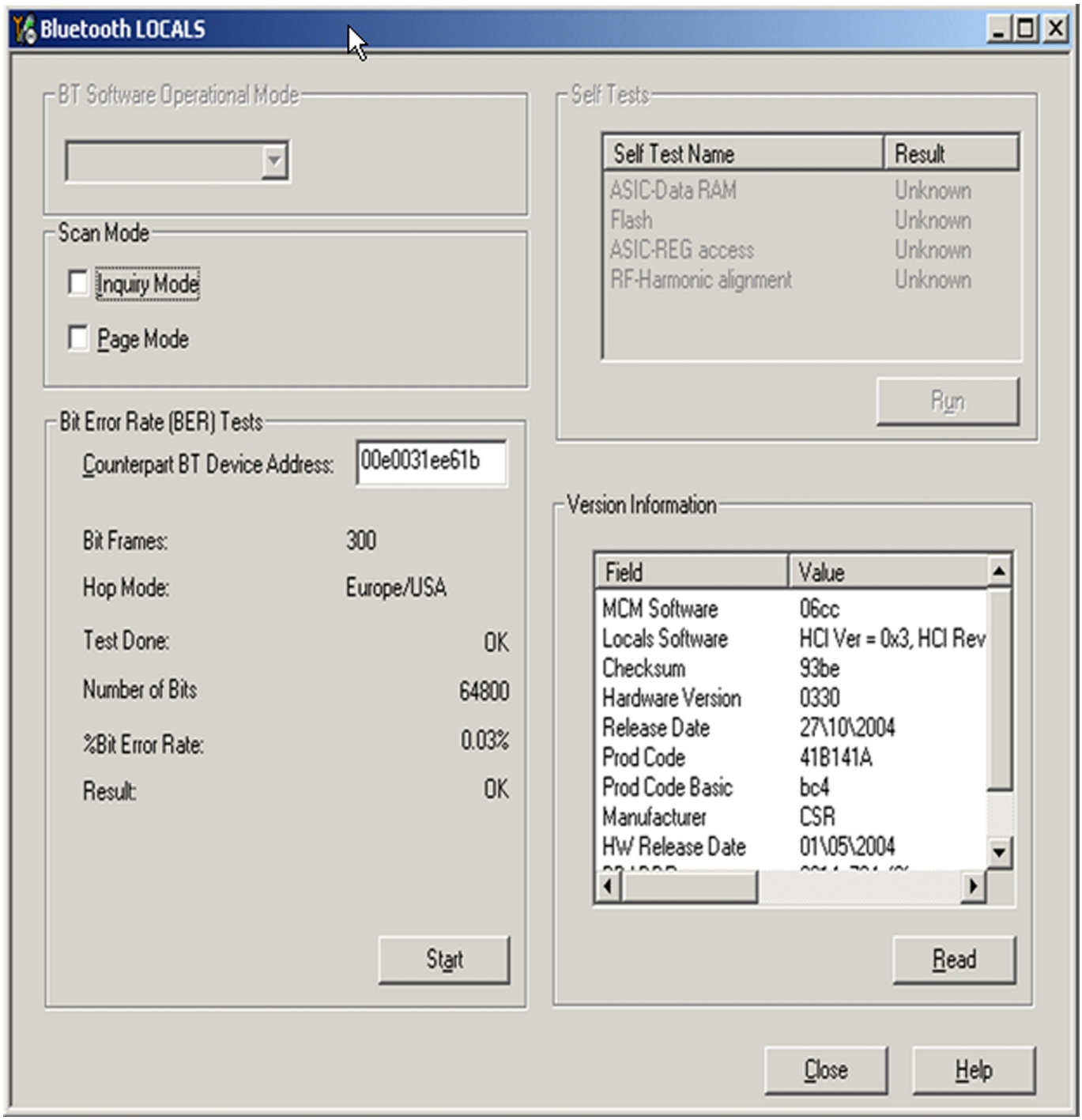
5. Locate the BT-box serial number (12 digits) found in the type label on the back of the JBT-9, or SB-6 Bluetooth test box.
6. In the Bluetooth LOCALS window, write the 12-digit serial number on the **Counterpart BT Device Address**line.
7. Place the BT-box near (within 10 cm) of the phone and click **Run BER Test**.



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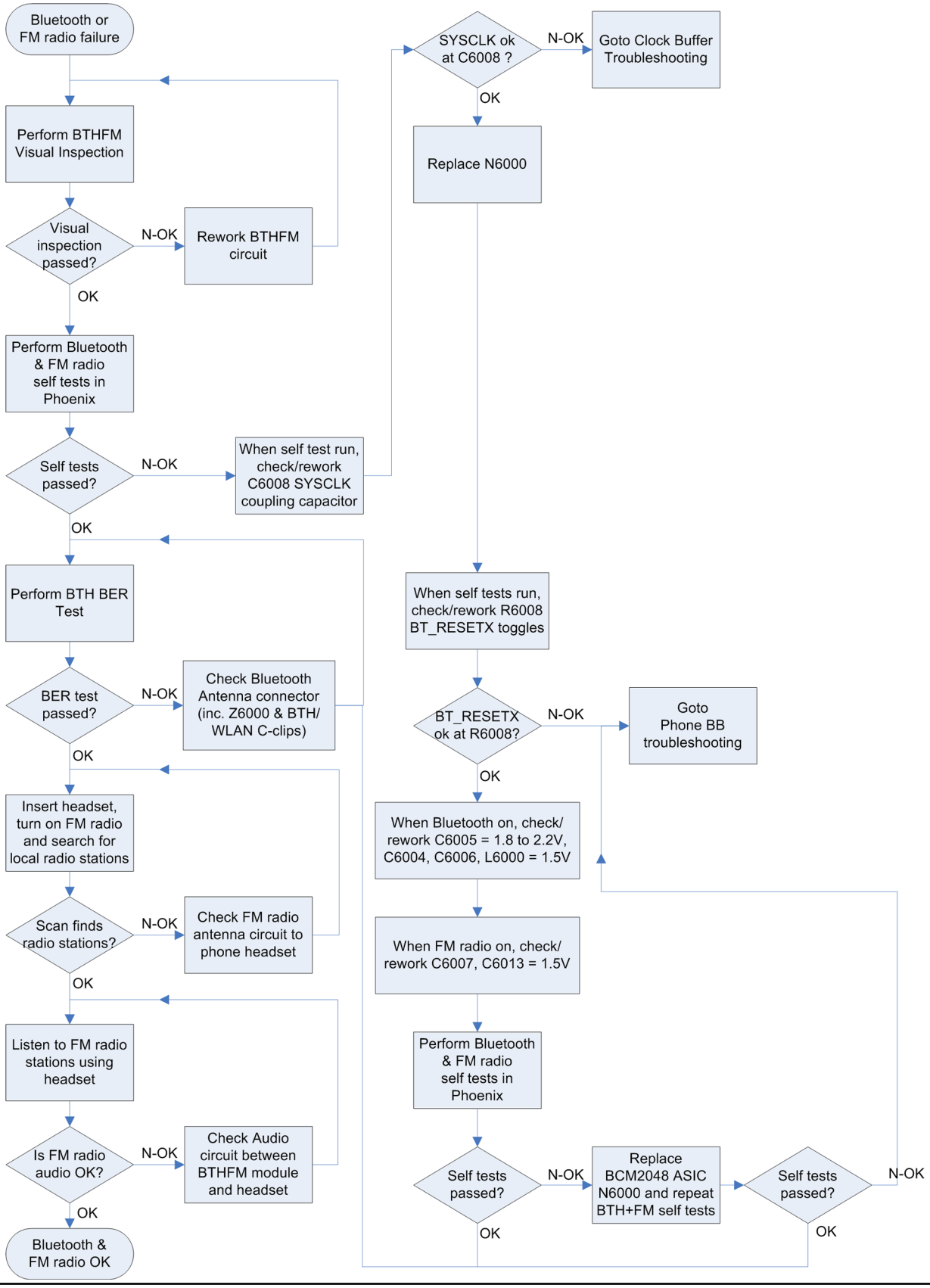
BTHFMRDS2.0D Discrete ASIC Circuit Troubleshooting Flow

Troubleshooting flow



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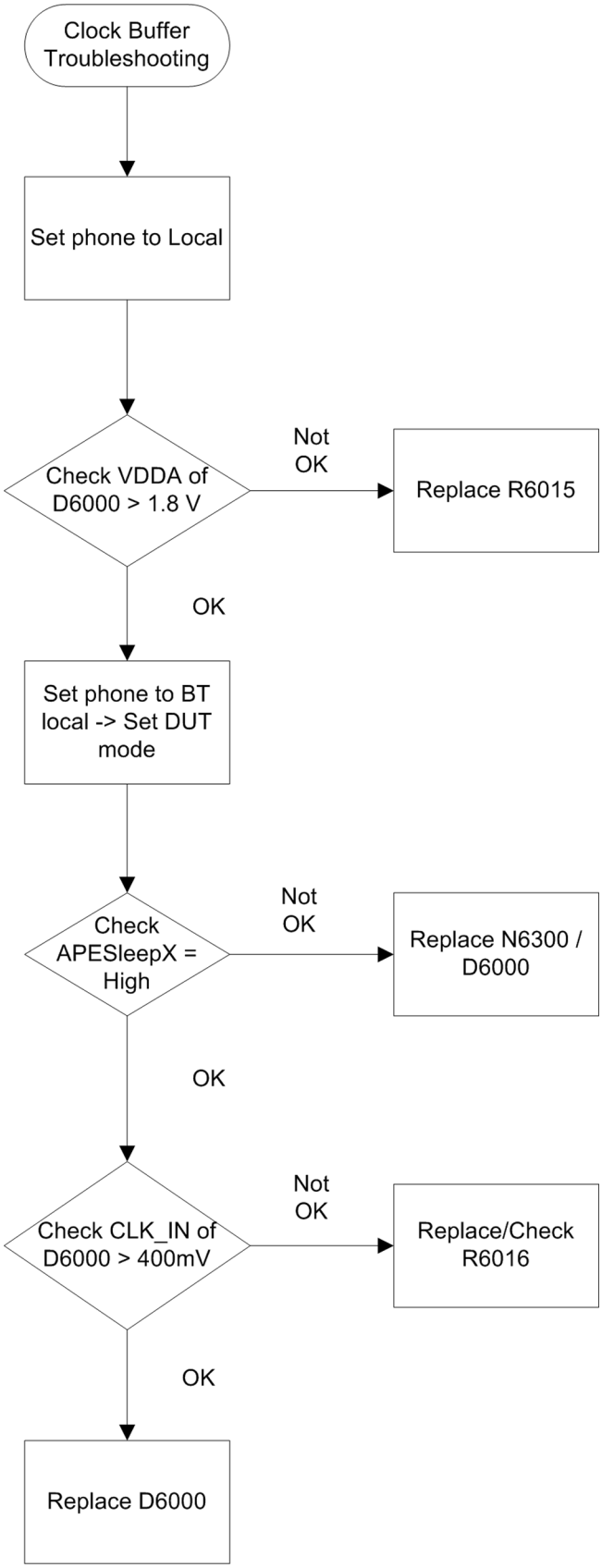

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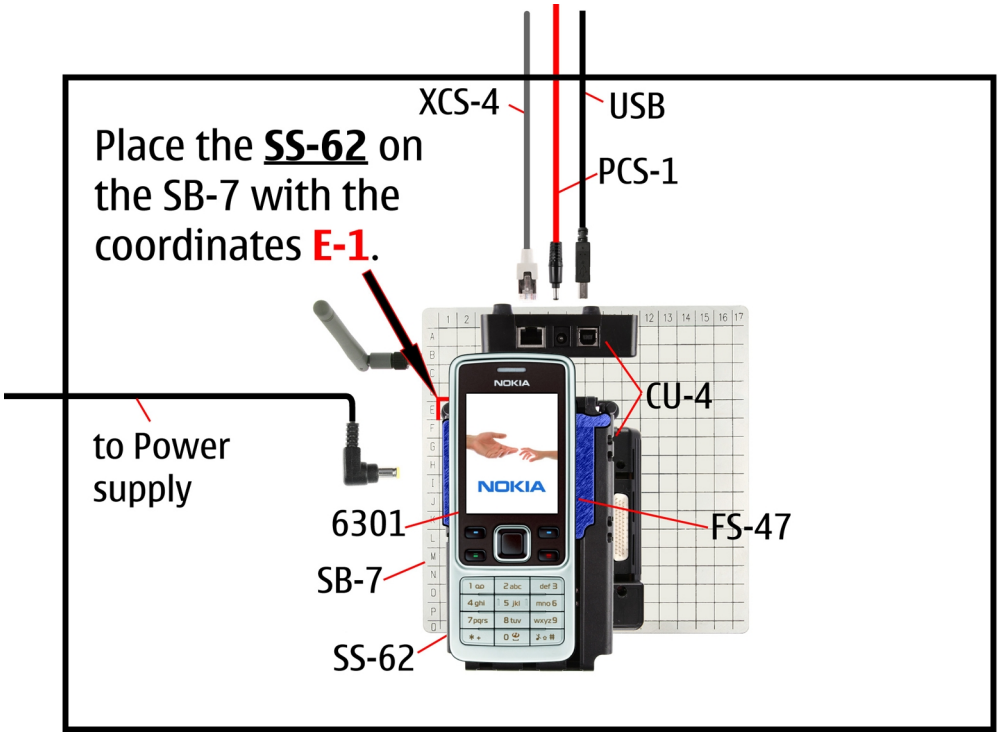
WLAN troubleshooting

WLAN functionality test using SB-7 and Phoenix

Steps

1. Place the phone on the SB-7 WLAN test box (see figure below). The co-ordinates are E1 - for the upper left foot.



2. Start *Phoenix* service software and turn the phone to the normal mode.
3. Make connection to RM-322 with *Phoenix*, if RM-322 powers up in local or test mode, then select **Normal** or **RF inactive mode** via the *Phoenix* **Operating mode** function.
4. Search for **SB-7 WLAN Test box** via **WLAN application**. Go to **Menu→settings→Connectivity→Wi-Fi**. Select the first item on the sub-menu **Available Networks**
5. If the name of the **WLAN test Box**"default" appears on the list of found networks, the RM-322 is OK.

   Note: Local WLAN environment may affect test results, especially if there are many WLAN access points nearby and any of them are using the same WLAN channel as SB-7. If the RM-322 is able to see and connect to local WLAN networks via its own inbuilt WLAN menu, then RM-322 is OK even if the SB-7 can not be detected. Consider repeating the test where local networks do not interfere with the lower strength signal of the SB-7 box.

   If you still can't find the name of the WLAN test Box (Default) on the list under Scan results, the RM-322 is not OK and you should proceed to WLAN troubleshooting.

WLAN layout and test points

The WLAN module has been optimised to achieve the smallest possible PWB area and adding test points will compromise this layout efficiency. There is also an added risk that test point will compromise the WLAN performance – the layout is quite sensitive and there have been EMC issues that were directly attributed to use of test points.

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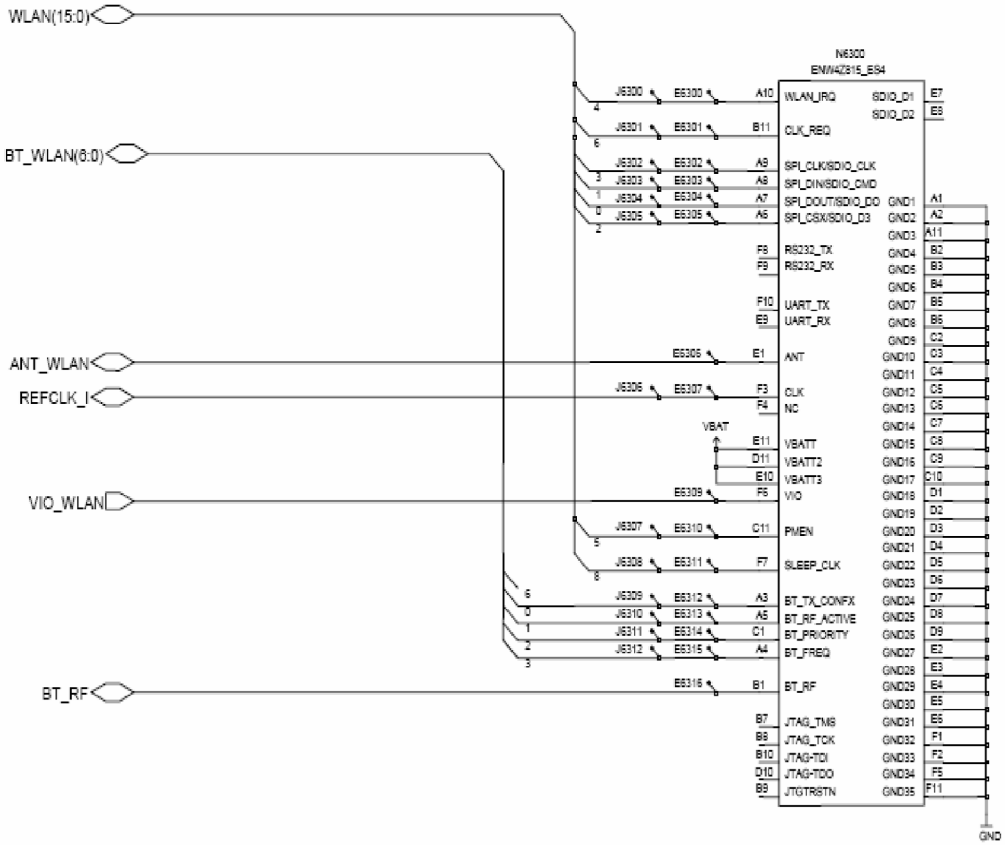
The recommendation is to use no test points and use software tests in Phoenix to verify the operation of the WLAN module. For reference, all test points provided on the schematic are summarised below.



The sequence of events during the start up of WLAN is:

1 PMEM is asserted high when Wlan module is first enabled by the Host.

2 WLAN module should respond by driving CLK REQ high to request the 38.4MHz clock.

3 Host engine turns on the 38.4MHz clock and then generates the SPI Clock to start the download of software to the WLAN module.

Adding more test points in a product is not strictly necessary.

WLAN settings for Phoenix

Use the following to test WLAN using Phoenix:

1 Set phone into Local Mode .

2 From the **File** menu, select **Scan Product** and check that the correct product version is displayed

3 From the **Testing** menu, select **Self Test**. This opens up a Self Test dialogue box, as shown below.

Select the **ST_WLAN_TEST** check box as shown and then select **Start** button. The test turns on the WLAN, sets up the SPI interface and then downloads the WLAN firmware into the WLAN module. During the download the WLAN acknowledges the data blocks and so the self test is a good way to confirm that the WLAN module is communicating with the Host. The result column will change to **Passed** after a few seconds if operating properly.

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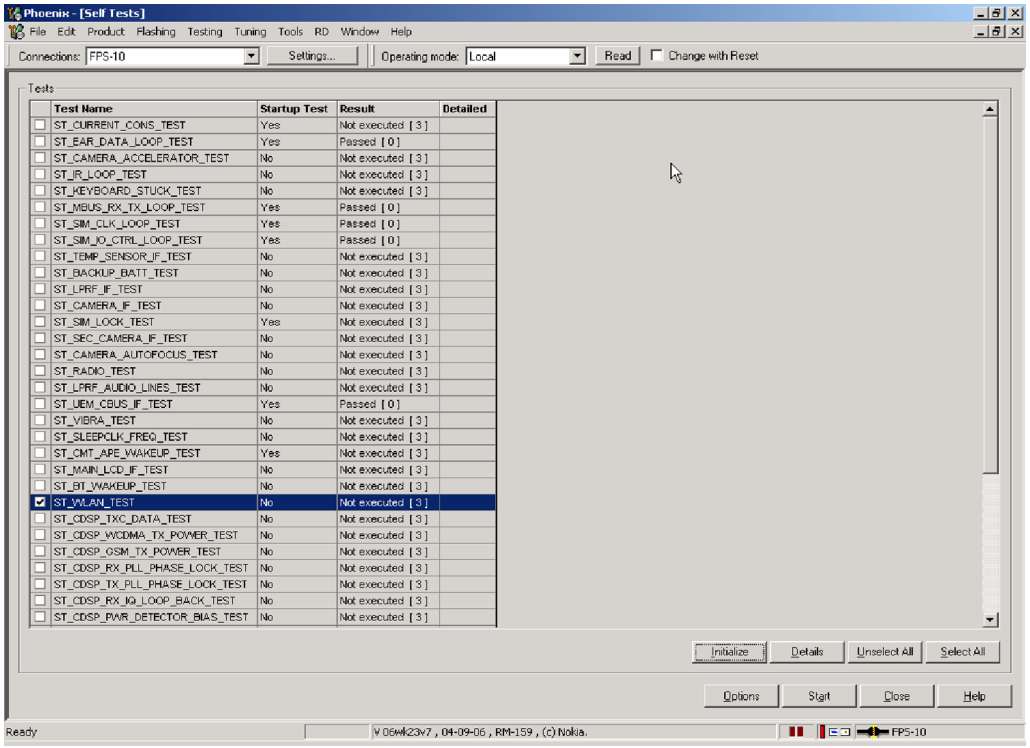
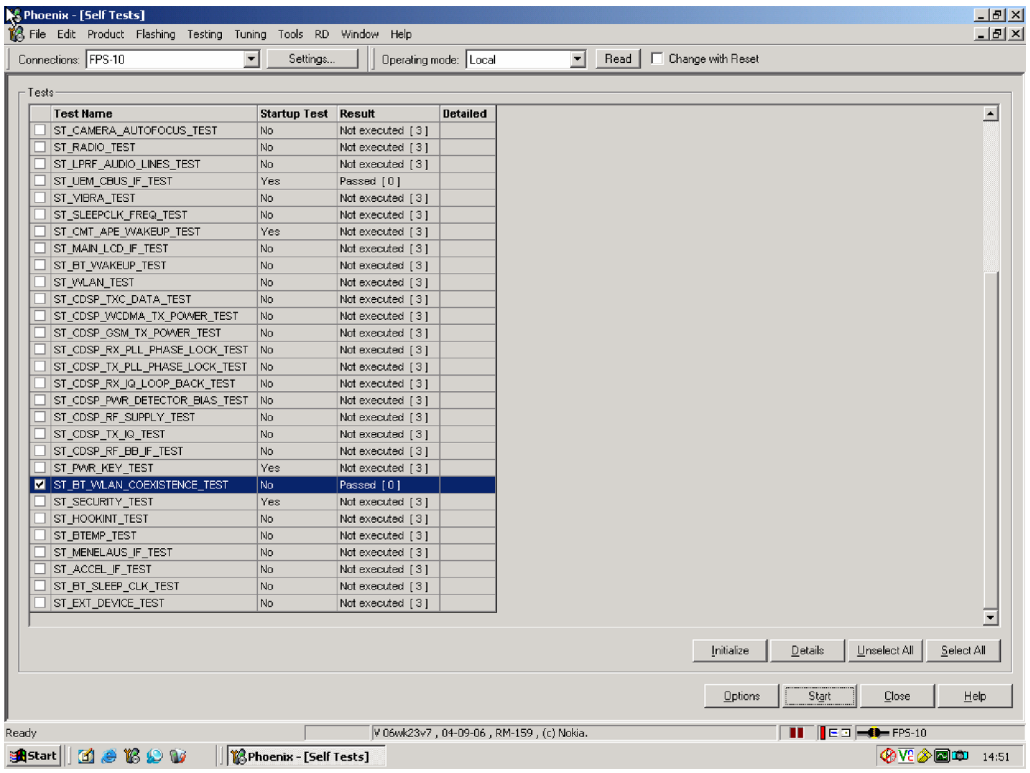


In addition, a test of the WLAN to BT interface can be done by selecting the **ST_BT_WLAN_COEXISTENCE_TEST** check box and selecting Start button.

This test verifies that the WLAN to BT co-existence interface signals are properly connected and there are no open circuit or shorts on the four interface signals.

The co-existence interface comprises BT Txconfig, BT RF Active, BT Priority, and BT Frequency.



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In summary these two Self tests provide a simple means of ensuring the Host engine is able to communicate with the WLAN module and check the interface to BT. More detailed WLAN performance test is covered in WLAN functional test section.

WLAN functional tests

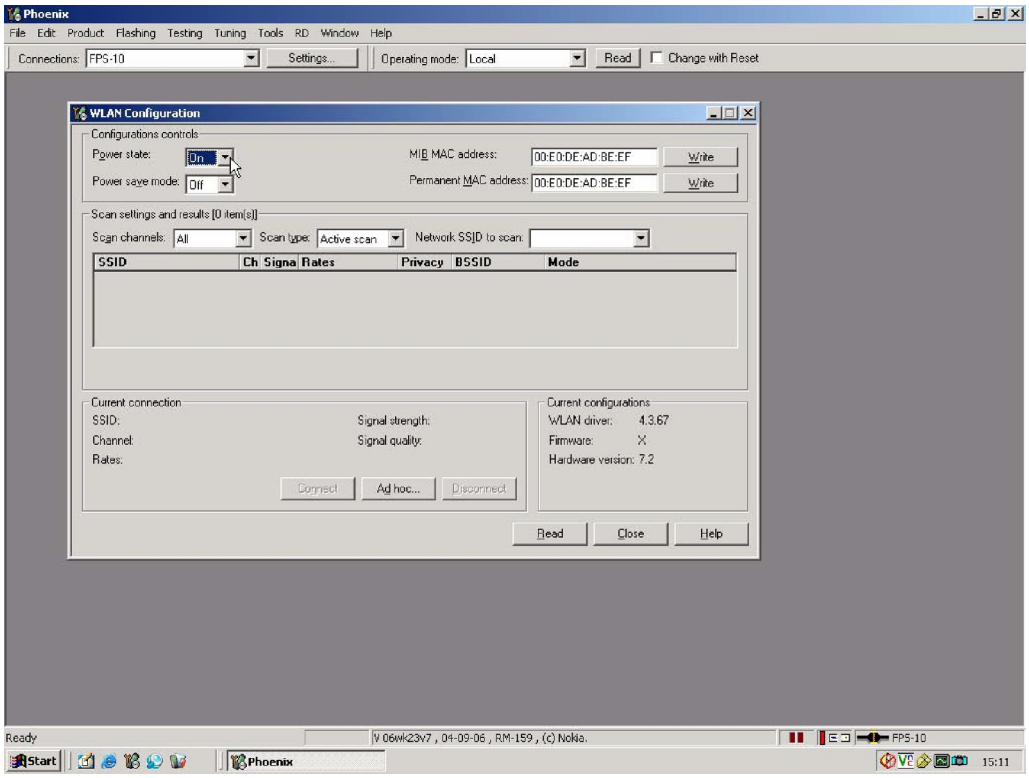
On/Off test

From the testing toolbar select **WLAN Configuration** option. This opens the WLAN configuration dialogue box below. Selecting the Power state option button (as indicated), the WLAN can be turned ON and OFF:

1 With Power State set to OFF, measure the dc power supply current consumption of the flash adaptor.

2 Next return the Power state to ON and re-measure the dc power supply current of the flash adaptor.

The difference between the currents in (1) and (2) should be between 160 to 200mA. When WLAN is ON, the firmware has been downloaded and the WLAN module is in the receive state. When OFF WLAN is powered down.



TX tests

From the testing toolbar select WLAN Tx Test option shown below. This test can be used to verify TX configuration and functionality. The default settings are sufficient for testing the TX operation, although other channels and data rates are equally suitable. To start the test, select the Start option button:

1 Measure and record the TX ON current consumption of the Phone/ flash adaptor.

2 Monitor the WLAN TX spectrum on a Spectrum analyser either using a co-ax cable connected to the WLAN TX antenna port or by making a radiated test with a suitable WLAN antenna connected to the spectrum analyser input. (When making a radiated test ensure that other WLAN devices are not transmitting as these may be detected as well, confusing the result).

3 To finish the test select the Finish option button

4 Measure the TX OFF current consumption of the phone/flash adaptor.

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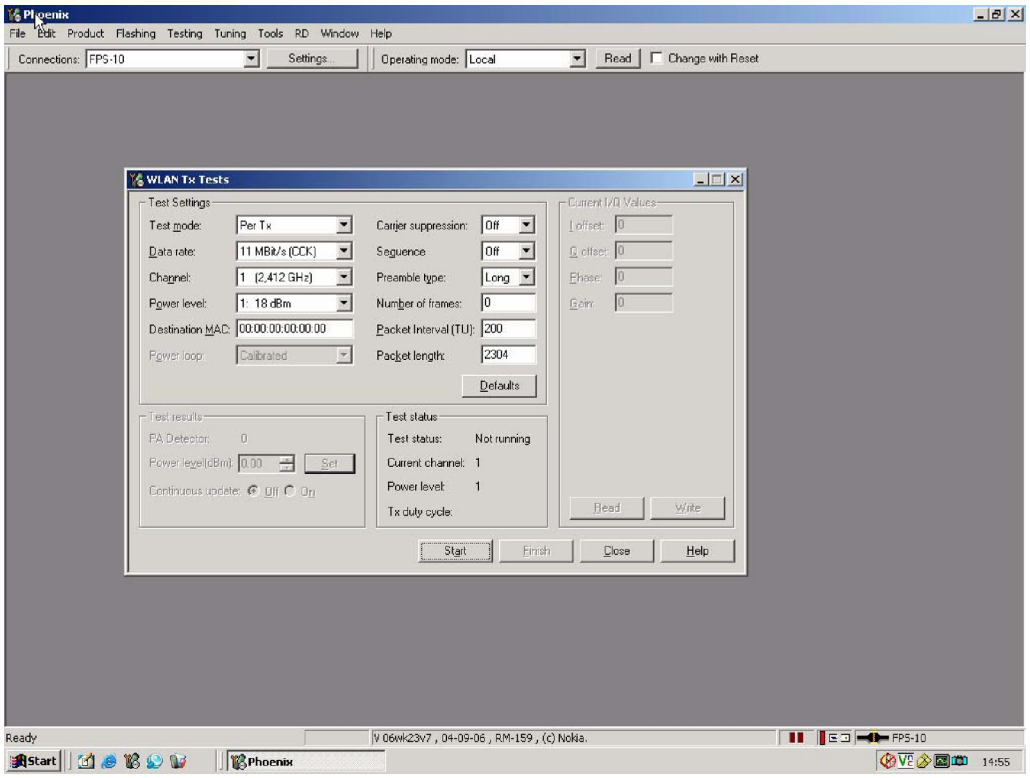
The difference between the two readings should be 100mA – 130mA and measures the transmit current in 11MBPS, 802.11b mode of operation.



RX Tests

There are different options available for testing the Rx path. The simplest is to use the WLAN to report Rx packets when operating in an area where there is an active WLAN network. Simply starting an Rx test will show the number of packets detected by the WLAN module as it monitors the network. However, it does require a properly configured WLAN network. The alternative approach is to make a conducted test using a signal generator connected to the WLAN antenna port. The drawback in this approach is that the WLAN antenna connection in the phone is not actually tested.

From the testing toolbar select WLAN Rx Test option shown below. This test can be used to verify Rx configuration and functionality.

To start the test, select the Start option button.

As the WLAN monitors an active WLAN network, the Rx test results window will update and show the number of Frames received, as well as the Packer error rate. If there is no data reported in the "Rx test results" screen, please change the "test channel" number.

Monitoring the detected frames is a simple method to verify the WLAN antenna and receiver path is working properly. The current consumption of the phone/flash adaptor before and during the Rx test should be the same (10 mA max difference).

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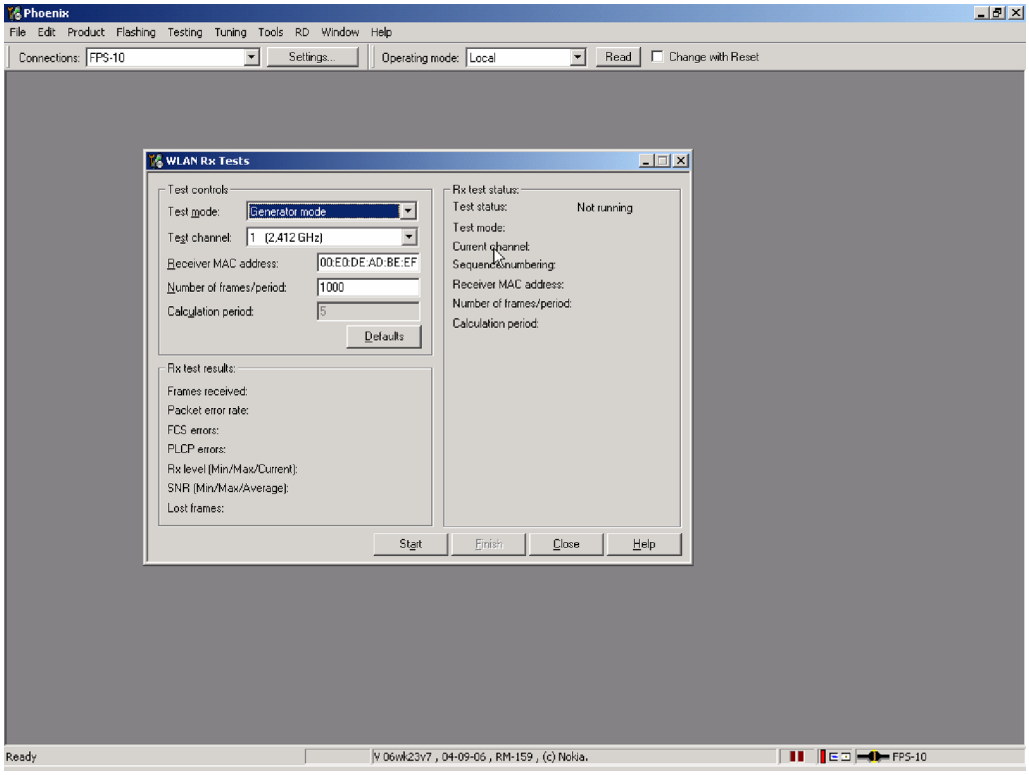

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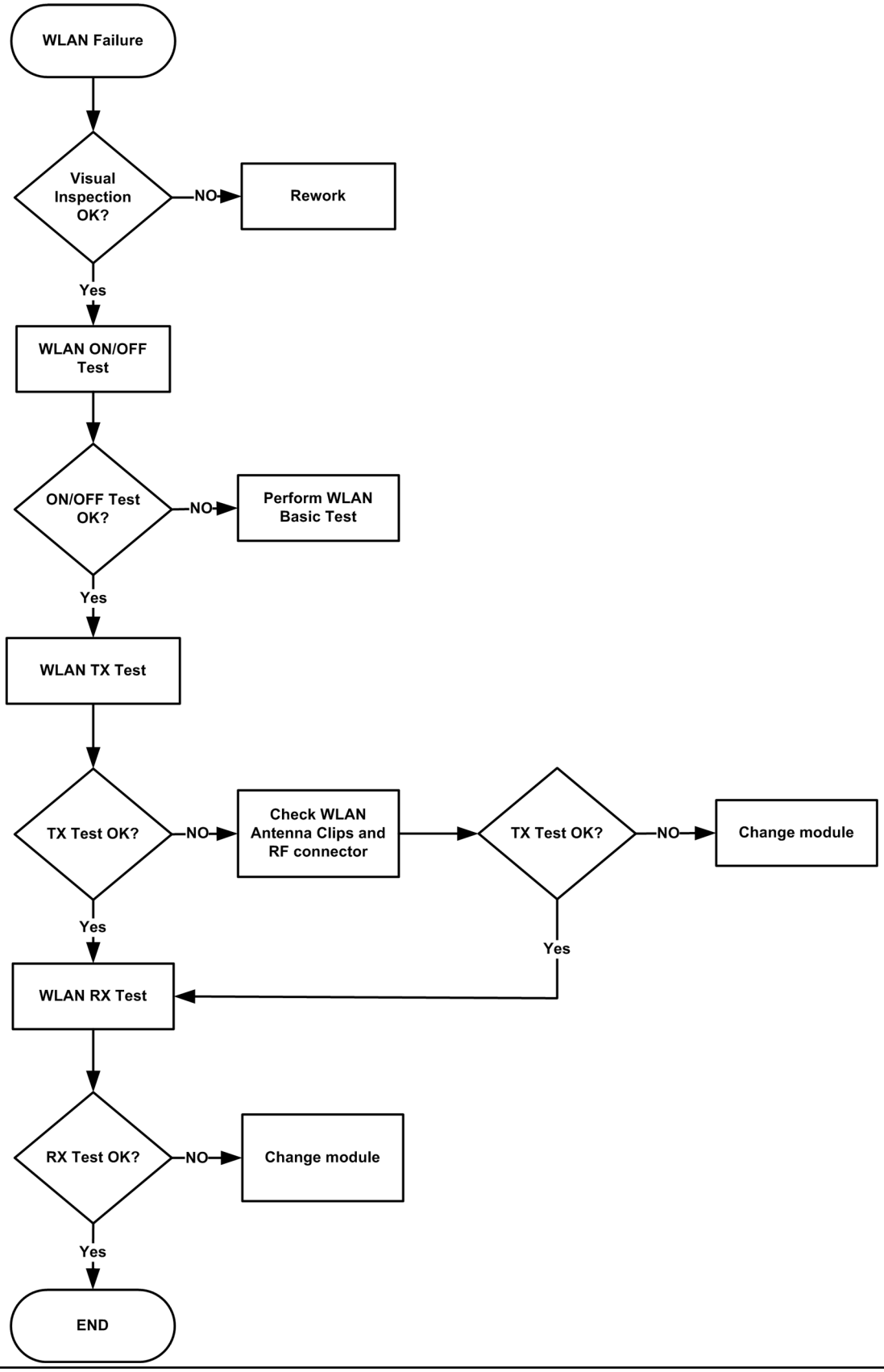
WLAN failure troubleshooting

Troubleshooting flow



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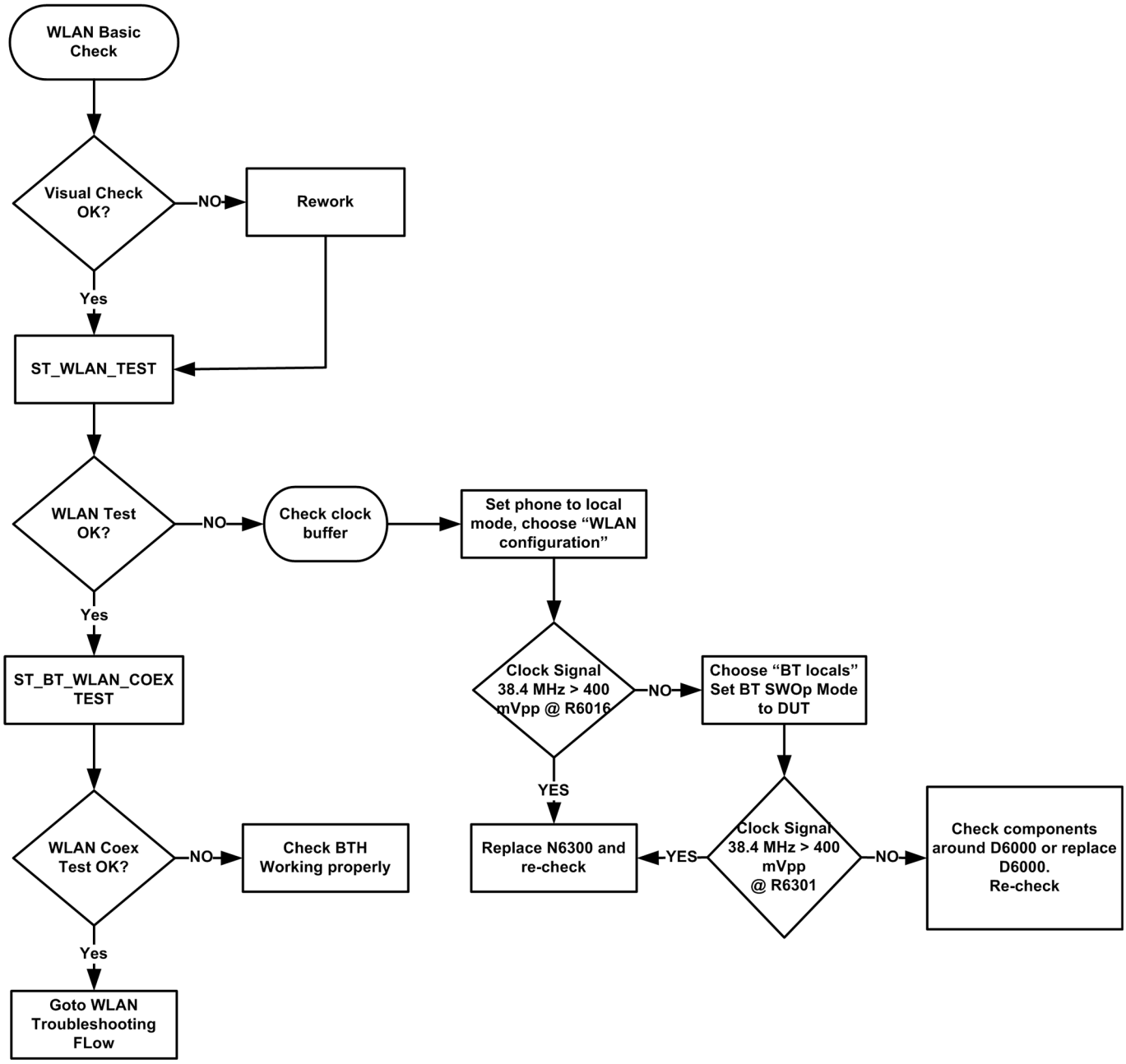
WLAN basic checks troubleshooting

Troubleshooting flow



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5 — System module

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Phone description

Introduction

This chapter describes the system module including engine, power management, interfaces, audio etc.

The baseband is based on BB5.0 with a RAPGSM main processor and Retu/Tahvo energy management. All blocks that require high voltage process are in Tahvo and all other in Retu. The RF part is based on the ASIC Ahne.

RM-322/323 is monoblock phone, in which all electrical components are assembled into one PWB.

RM-322 operates on the GSM 900/1800/1900 bands.

RM-323 operates on the GSM 850/1800/1900 bands.

Key components

Function	Name	Item
Energy management	Retu Tahvo	D2200 N2300
Main processor	RAPGSM	D2800
Memory	Combo: 256 Mbit SDRAM & 512 Mbit NOR Flash	D3000
RF ASIC	Ahne	N7505
Front end module	Power amplifier and Antenna Switch	N7520
Antenna	Antenna module assembly • RM-322: 900/1800/1900 MHz • RM-323: 850/1800/1900 MHz	
System connector	AV connector mini USB connector	X2030 X2002
Battery	BL-4C, 3.7 V, 860 mAh	
Bluetooth	BCM2048	D6000
FM radio	BCM2048	D6000
IHF Speaker	Donau (in antenna module assembly)	
Earpiece	RDF-07A 32OHM 10.86x7.40.2.2	B2101
Microphone	Clapton	B2100
Vibra	SMD VIBRA MOTOR	M2100
Charger connector	2 mm Nokia charger interface	X2000
Camera	2.0 Mpix SMIA85	
HWA	STV0984N	D3300
Display	QVGA 240 x 320, 2"	
LED driver	TPS 61061 YZFR	N2301
RTC battery	311 size	G2200
WLAN	WLAN Size 4.0	N6300

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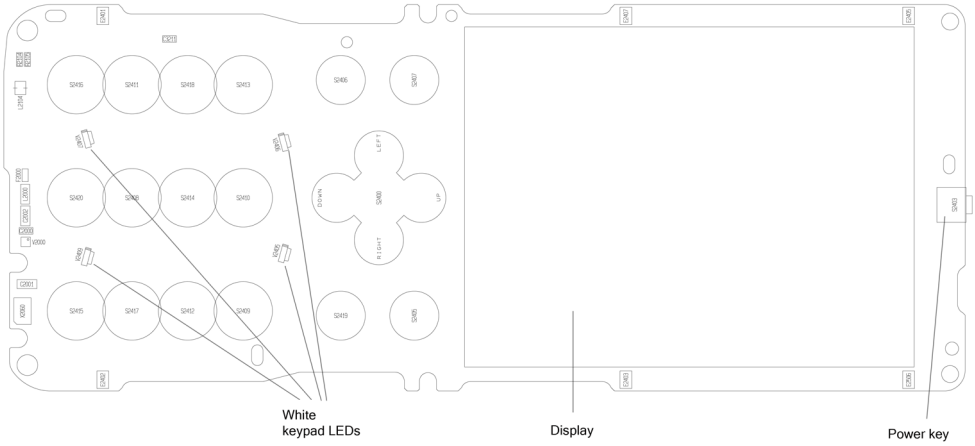
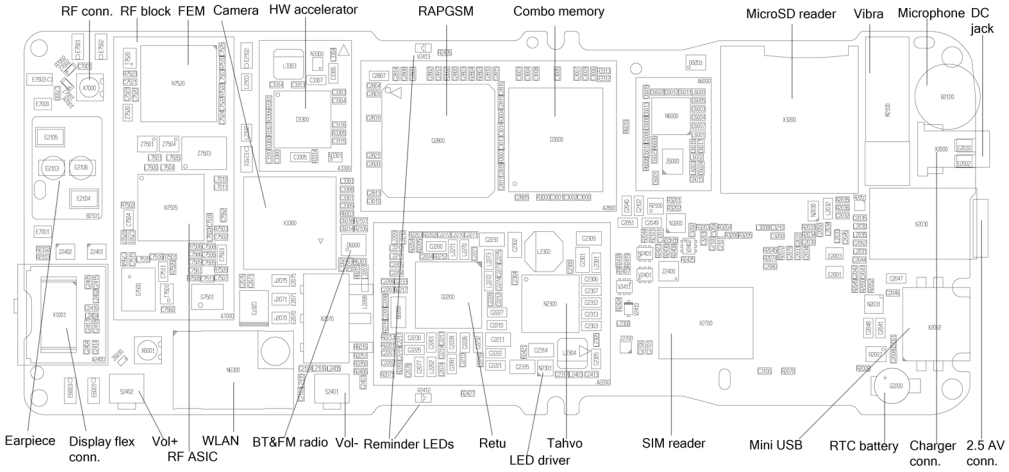
PWB overview





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System block diagram

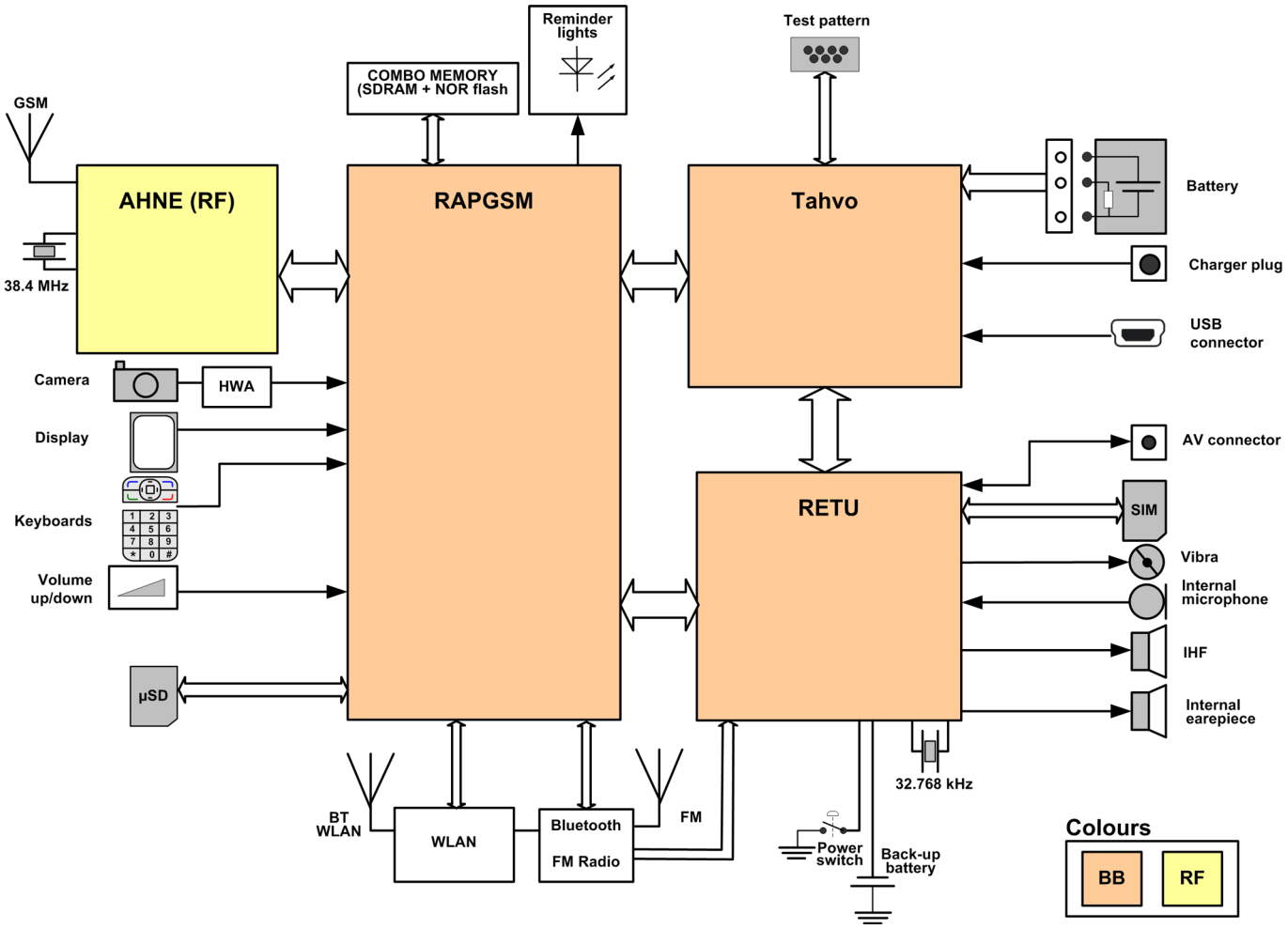

Figure 25 System block diagram

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Board and module connections

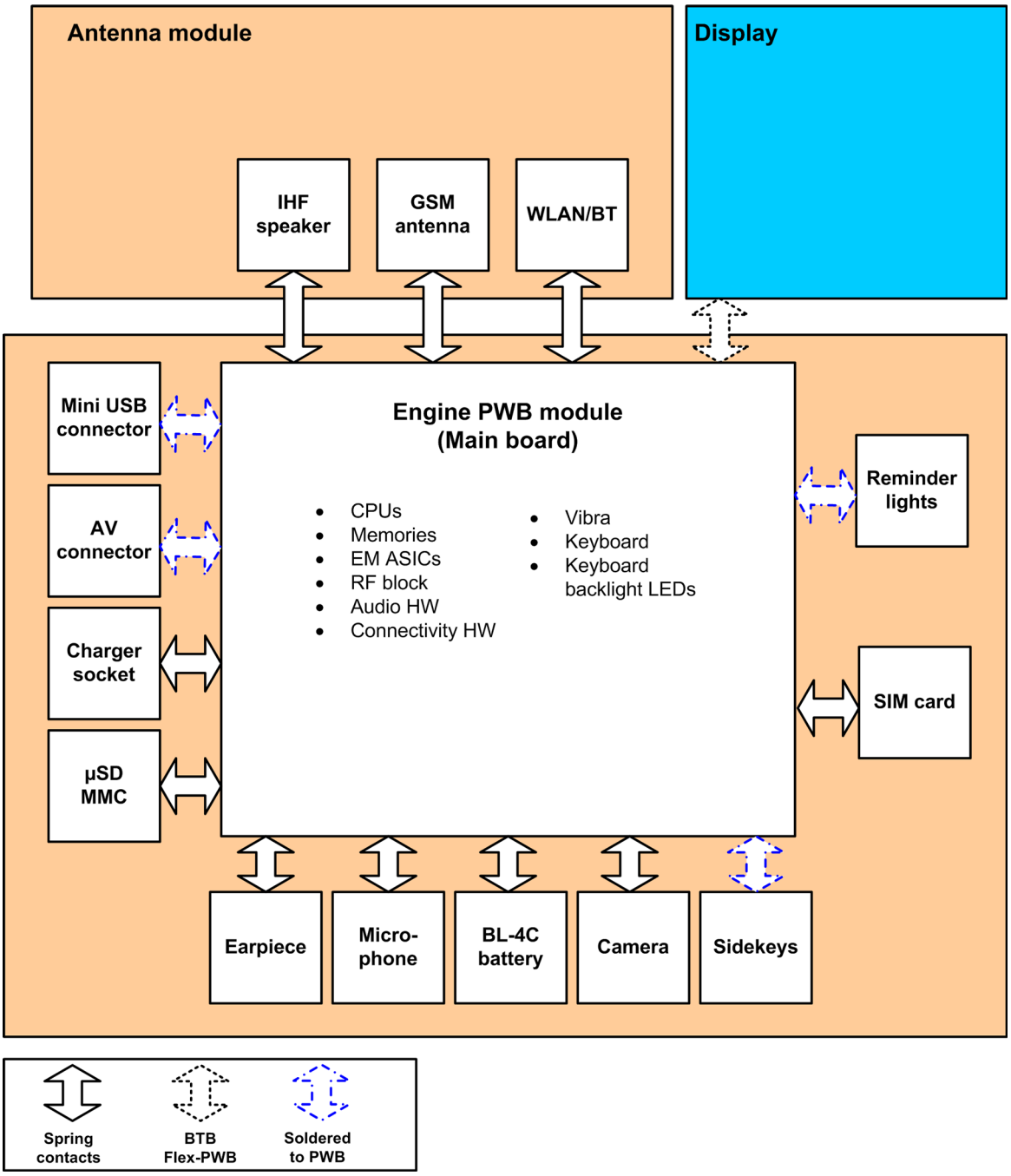

Figure 26 Board and module connections

Engine

Engine modules

The engine contains

- RF block with Ahne ASIC and front end module
- RAPGSM main processor
- Energy management - Retu and Tahvo

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- Combo memory with SDRAM and NOR flash

RF engine

The RF module performs the high frequency operations of the engine for GSM. In both transmitter and receiver, the modulator and demodulator operate at the channel frequency.

The core components of the RF module are:

- Ahne RF ASIC (application specific integrated circuit)
- Front end module (FEM) (Power amplifier and Antenna switch)

The RF engine also includes:

- Voltage controlled oscillators (VCO and VCTCXO)
- SAW filters

The baseband section controls the RF module through the serial bus, RFBus. This passes information about eg. frequency band and mode of operation. Ahne RF ASIC controls the mode of operation, and further sends control signals to the front end module.

In addition to the RFBus there are other interface signals for the power control loop, VCTCXO control and for the modulated waveforms.

Main processor

The main processor in this device is RAPGSM, a BB5.0 ASIC.

Some of its interfaces, processors and controllers are:

- General purpose UARTs
- Processor modules
- I2C (between ICs) interface
- GSM coder
- Interfaces to user interface, SIM and MMC
- Accessory interface
- Handling of RF-BB interface
- I/O voltage = 1.8 V, Core voltage <1.8 V

Energy management

Two ASICs manages the energy in the phone; Retu and Tahvo. Together they cover the analogue audio and energy management function needs.

Tahvo

All blocks that need a special silicon process are included in Tahvo.

Tahvos main features are:

- Energy management control
- Supply voltage generation
- Charge control
- Digital core supply
- Current control for LED supply

Retu

The blocks that do not have special needs are included in Retu.

Retu controls for example:

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- Audio block
- SIM
- FM radio

Modes of operation

The functional behavior can be divided into seven different states. Each of these states will affect the general functionality of the phone:

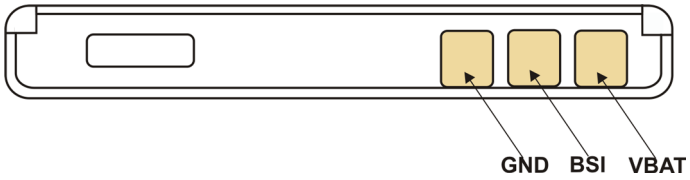
- No supply
- Backup
- Power off
- Reset
- Power on
- Deep sleep

Battery and charging

Battery

- Type: BL-4C, Li-Ion
- Capacity: 860 mAh
- BSI resistor nominal value: 75 kΩ

Battery temperature is measured on the NTC on the main board.



Battery connector

The battery connector has three contacts:

- BSI (Battery size indicator)
- GND (Ground)
- VBAT (Battery voltage)

The BSI line is used to recognize the battery capacity by a battery internal pull down resistor.

Charging

This phone is charged through the smaller Nokia standard interface (2.0 mm plug). The old standard charger (3.5 mm) can be used together with the CA-44 charger adapter.

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Figure 27 Old (left) and new (right) charger plugs

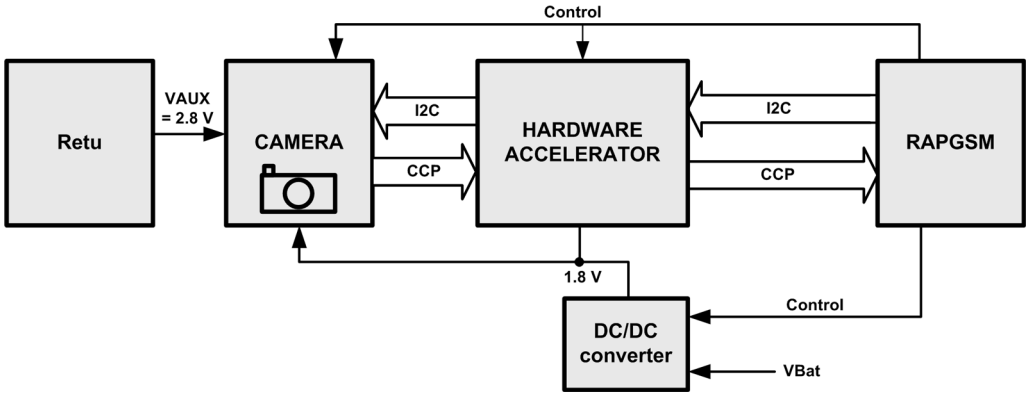
Charging is controlled by energy management, and external components are needed to protect the baseband module against EMC, reverse polarity and transient frequency deviation.

Interfaces

Camera

Camera interface

The RM-322/323 has a **2.0 Megapixel** camera, supported by a hardware accelerator.



SIM

The SIM interface is the electrical interface between the SIM card and the mobile phone engine.

The data communication between the SIM card and the phone is asynchronous half duplex.

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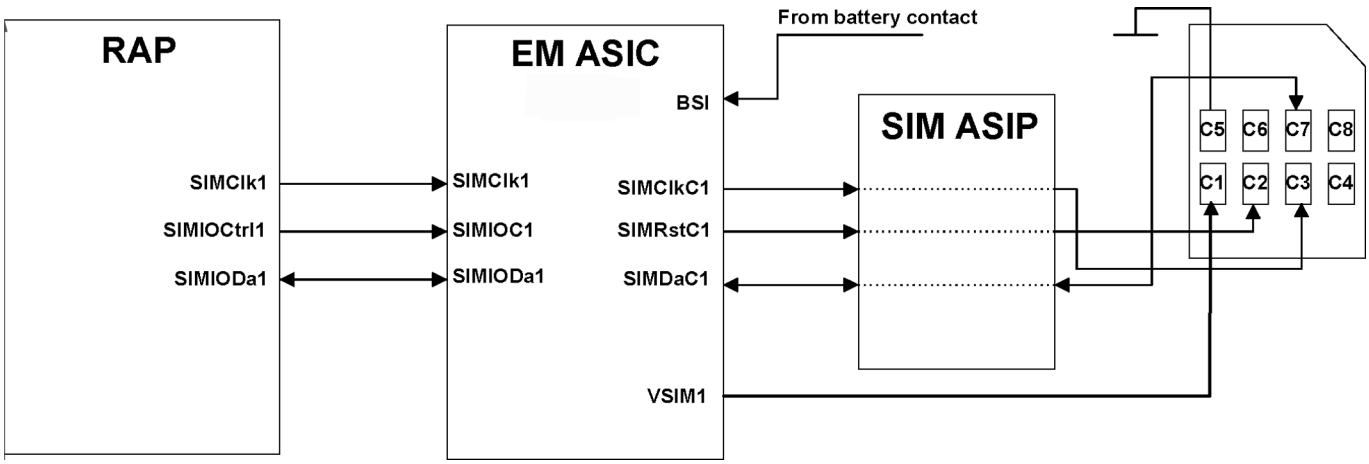


Figure 28 SIM interface connections

SIM Logic level shifting

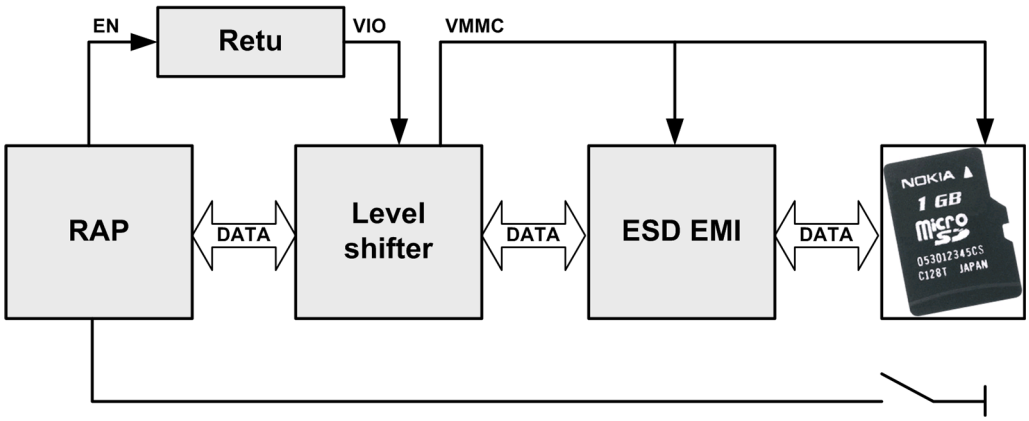
The SIM interface can support 3V and 1.8V SIM cards.

SIM Power up/down

The SIM power up/down sequence is generated in Retu. This means that Retu generates the reset switch (RST) signal to the SIM. In addition, the SIMCardDet signal is connected to Retu.

The SIM interface is powered up when the SIMCardDet signal indicates “card in”.

µSD card interface



The µSD card is connected to the engine by an external level shifter and ESD protection filter. Supplied voltages:

- VMMC: 2.85 V (from level shifter)
- VIO: 1.8 V (from Retu)

The card removal is detected by a push detect switch.

User interface

Display

The display unit comprises a parallel interface.

Keyboard

All keys are placed on the main PWB.

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- Numeric keys
- Navigation key, Soft keys, Start, and End
- Power switch
- Volume up and down switch

Display and keypad backlight

There are two sets of LEDs illuminating the display and the keypads:

- Display LEDs, 4pcs
- Main keypad on PWB, 4 pcs, white colour

All sets share the same driver. None of the keypads can be illuminated without the LCD backlight being turned on.

Reminder lights

Two additional coloured (blue or orange) LEDs serve as reminder lights for missed calls/text messages.

Audio concept

Audio concept

The functional core of the audio hardware is built around two ASICs; RAP engine and Retu.

Retu provides an interface for the trancducers and the AV connector.

There are three audio transducers:

- 1 dynamic earpiece
- 1 dynamic speaker
- 1 microphone module

Retu also provides an output for the vibra motor.

All external audio accessories are connected to the specific audio connector.

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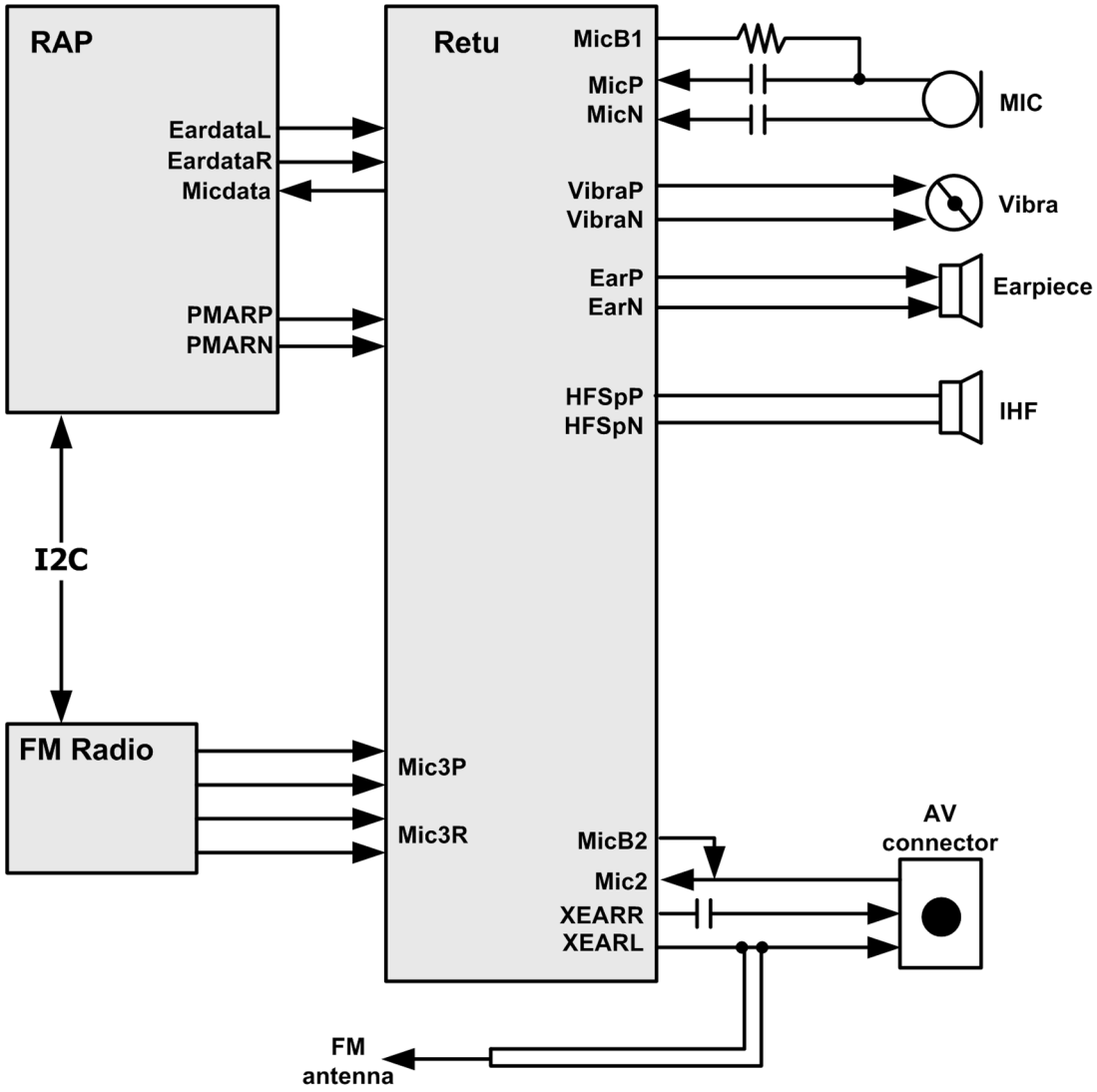

Figure 29 Audio block diagram

Internal audio

The internal audio components are used in these modes:

	Hand portable (HP) mode	Internal hands free (IHF) mode
Microphone	X	X
Earpiece	X	
Speaker		X

Connections

AV connector

Headsets and other galvanic accessories are connected to the specific audio input. The accessory mode is automatically enabled/disabled when a dedicated accessory is connected/disconnected.

Note: When testing external audio through the audio connector, make sure that the specific accessory can be used with this phone!

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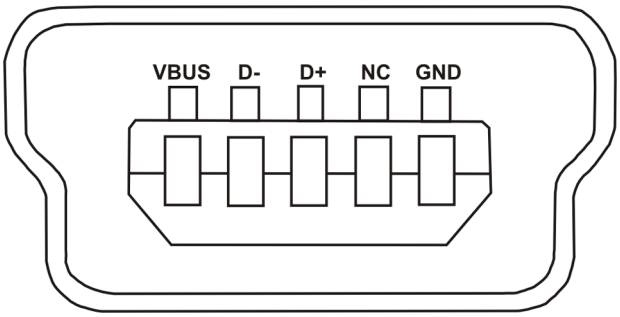
USB

USB (Universal Serial Bus) provides a wired connectivity between a PC and peripheral devices. It is a differential serial bus.

USB 2.0 is supported with full speed (12 Mbps).

Hot swap is supported, which means that USB devices may be plugged in/out at any time.

This phone is provided with a specific connector for mini USB.



Bluetooth

Bluetooth provides a fully digital link for communication between a master unit and one or more slave units.

This bluetooth solution is a single chip solution.

Bluetooth connects to RAPGSM on the GENIO and GPIO busses.

The Bluetooth module is provided with power from VBat.

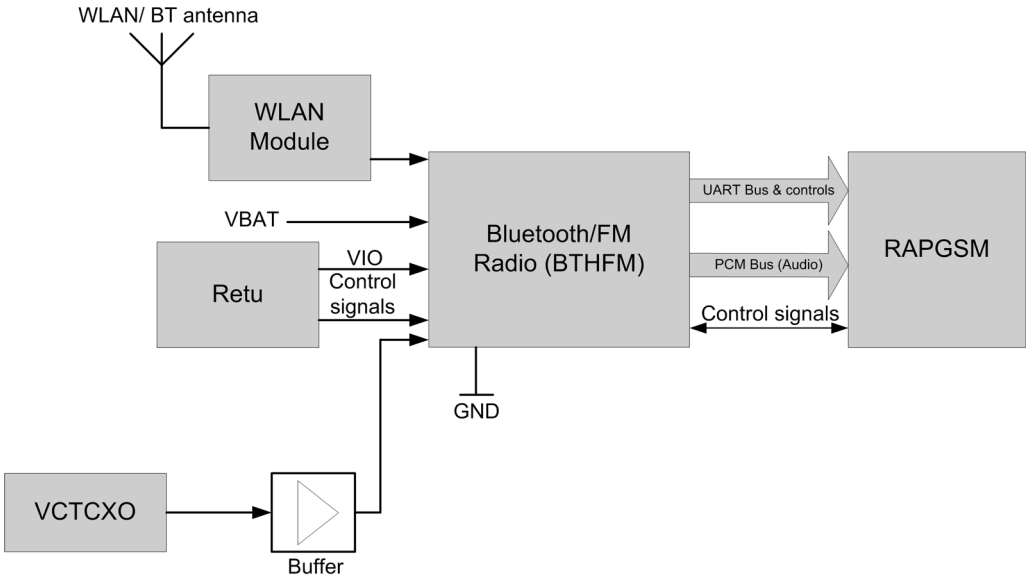


Figure 30 Bluetooth interface block diagram

WLAN system overview

The WLAN Size4.0 solution is a fully integrated wireless radio solution based on TI TNET1251. The module includes the single chip transceiver, PM solution and the FEM. The module itself is manufactured by Panasonic using standard FR4 substrate.

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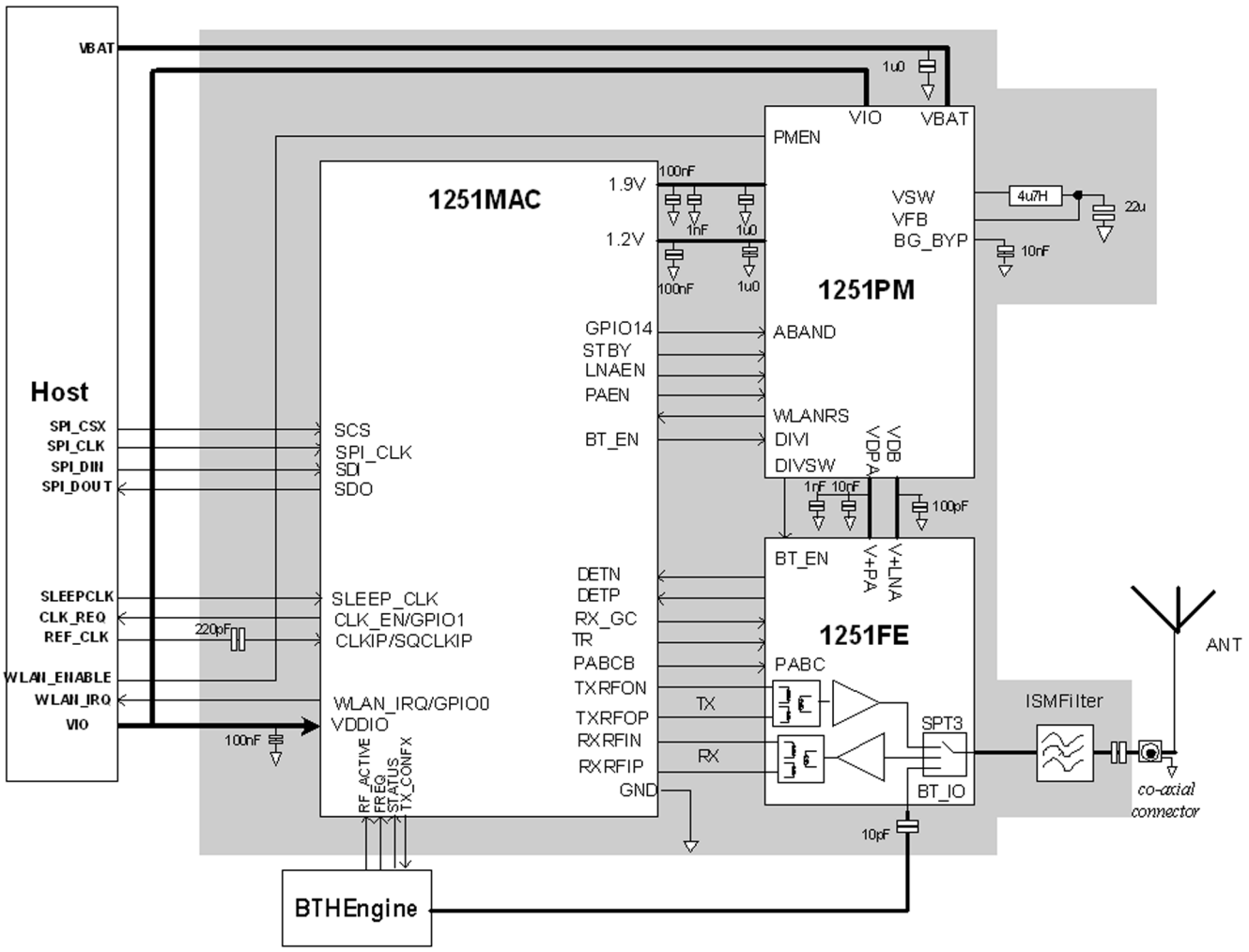

Figure 31 WLAN block diagram

Functional description

The WLAN Size 4.0 module is a single component Wireless Local Area Network (WLAN) radio access technology supporting the IEEE 802.11 standards, for low error rate data transfer between mobiles and WLAN networks. It incorporates a highly optimised WLAN chipset for mobile applications where low cost, small physical size and low power consumption are important attributes.

The Size 4.0 module houses a medium access controller (MAC) spread spectrum baseband processor with direct conversion radio interface, a 2.4GHz RF Front End chip and Power Management (PM) IC. Data rates up to 54Mbps are possible in 802.11g mode of operation.

The Front end chip provides low noise power amplification, power detection and RF switching functions. It also provides an extra RF port, so that Bluetooth can operate and share the antenna with WLAN.

The baseband processor includes the direct conversion radio stage and MAC. The radio is responsible for the modulation and demodulation of data and scrambling/encoding of data according to information supplied by the MAC. The power management IC provides power to the baseband processor and FE. It incorporates an SMPS and linear regulators allowing the WLAN to operate directly from the cellular phone battery.

The WLAN SW is downloaded from the host engine when the WLAN is turned on, over the dedicated SPI interface.

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The 38.4 MHz reference clock from the host engine is shared with other radio technologies (e.g. Bluetooth) and WLAN uses the clock request signal to request the reference clock to be turned on when WLAN needs to use it.

Technical specifications

General specifications

Unit	Dimension (mm)	Weight (g)	Volume (cc)
Transceiver with BL-4C 860 mAh Li-Ion battery pack	106,8 x 43,8 x 13,1	91	55,6

Battery endurance

Battery	Talk time	Standby time	Music time
BL-4C 860 mAh Li-ion	3 - 3.5 hours	Up to 300 hours	> 10 hours

Note: Variation in operation times will occur depending on SIM card, network settings and usage. Talk time is increased by up to 30% if half rate is active, and reduced by 5% if enhanced full rate is active.

Environmental conditions

Temperature

Temperature range	Min °C	Max °C
Operational (all specs met)	-5	+55
Functional (reduced performance)	-30	+70
Storage	-30	+85

The HW module complies with the SPR4 Operating Conditions.

Humidity

Relative humidity range is 5...95%.

The hardware module is not protected against water. Condensed or splashed water might cause malfunction. Any submerge of the phone will cause permanent damage. Long-term high humidity, with condensation, will cause permanent damage because of corrosion.

The hardware module complies with the SPR4 Operating Conditions.

Electrical characteristics

Table 11 Normal and extreme voltages

Voltage	Voltage (V)	Condition
General conditions		
Nominal voltage	3.7	

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Voltage	Voltage (V)	Condition
Lower extreme voltage	3.06	a
Higher extreme voltage	4.2	b

a. ADC settings in the SW might shutdown the phone above this value.

b. During fast charging of an empty battery, this voltage might exceed this value. Voltages between 4.20 and 4.60 might appear for a short while.

Main RF characteristics

Table 12 Channel numbers and frequencies

System	Channel number	TX frequency	RX frequency	Unit
GSM850	128 <= n <= 251	F = 824.2 + 0.2*(n - 128)	F = 869.2 + 0.2* (n-128)	MHz
GSM900	0 < =n <= 124	F = 890 + 0.2*n	F = 935 + 0.2*n	MHz
	975 <= n <= 1023	F = 890 + 0.2* (n - 1024)	F = 935 + 0.2*(n -1024)	MHz
GSM1800	512 <= n <= 885	F = 1710.2 + 0.2* (n - 512)	F = 1805.2 + 0.2* (n-512)	MHz
GSM1900	512 <= n <= 810	F = 1850.2 + 0.2* (n - 512)	F = 1930.2 + 0.2* (n-512)	MHz

Table 13 Main GSM characteristics

Parameter	Unit and value
Cellular systems	**RM-322**: EGSM900/GSM1800/GSM1900 **RM-323**: GSM850/GSM1800/GSM1900
RX Frequency range	GSM850: 869 ... 894 MHz
	EGSM900: 925 ... 960 MHz
	GSM1800: 1805...1880 MHz
	GSM1900: 1930...1990 MHz
TX Frequency range	GSM850: 824 ... 849 MHz
	EGSM900: 880 ... 915 MHz
	GSM1800: 1710 ...1785 MHz
	GSM1900: 1850...1910 MHz
Duplex spacing	GSM850: 45 MHz
	EGSM900: 45 MHz
	GSM1800: 95 MHz
	GSM1900: 80 MHz
Channel spacing	200 kHz

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Parameter	Unit and value
Number of RF channels	GSM850: 124
	EGSM900: 174
	GSM1800: 374
	GSM1900: 300
Output Power	GSM850: GSMK 5...33 dBm
	GSM850: 8-PSK 5...26.5 dBm
	EGSM900: GSMK 5...33 dBm
	EGSM900: 8-PSK 5...26.5 dBm
	GSM1800: GSMK 0...30 dBm
	GSM1800: 8-PSK 0...25.5 dBm
	GSM1900: GSMK 0...30 dBm
	GSM1900: 8-PSK 0...25.5 dBm
Number of power levels GMSK	GSM850: 15
	EGSM900: 15
	GSM1800: 16
	GSM1900: 16
Number of power levels 8-PSK	GSM850: 12
	EGSM900: 12
	GSM1800: 14
	GSM1900: 14

Table 14 GSM Transmitter characteristics

Item	Values
Type	Direct conversion, nonlinear, FDMA/TDMA
LO frequency range	GSM850: 3296...3576 MHz (4 x TX freq)
	EGSM900: 3520...3660 MHz (4 x TX freq)
	GSM1800: 3420...3570 MHz (2 x TX freq)
	GSM1900: 3700...3820 MHz (2 x TX freq)
Output power (GSM850/EGSM900/GSM1800/ GSM1900)	GMSK 33/33/30/30 dBm 8-PSK 26.5/26.5/25.5/25.5 dBm
Gain control range	min. 30 dB
Phase error (RMS/peak), GMSK	5 deg./20 deg. peak
EVM (RMS/peak), 8-PSK	10%/30%

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Table 15 GSM Receiver characteristics

Item	Values
Type	Direct conversion, Linear, FDMA/TDMA
LO frequencies	GSM850: 3476..3576 MHz (4 x RX freq)
	EGSM900: 3700...3840 MHz (4 x RX freq)
	GSM1800: 3610...3760 MHz (2 x RX freq)
	GSM1900: 3860...3980 MHz (2 x RX freq)
Typical 3 dB bandwidth	+/- 91 kHz
Sensitivity	min. - 102 dBm (normal condition)
Total typical receiver voltage gain (from antenna to RX ADC)	86 dB
Receiver output level (RF level -95 dBm)	40 mVpp, single-ended I/Q signals to RX ADCs

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Glossary

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A/D-converter	Analogue-to-digital converter
ACI	Accessory Control Interface
ADC	Analogue-to-digital converter
ADSP	Application DPS (expected to run high level tasks)
AGC	Automatic gain control (maintains volume)
ALS	Ambient light sensor
AMSL	After Market Service Leader
ARM	Advanced RISC Machines
ARPU	Average revenue per user (per month or per year)
ASIC	Application Specific Integrated Circuit
ASIP	Application Specific Interface Protector
B2B	Board to board, connector between PWB and UI board
BB	Baseband
BC02	Bluetooth module made by CSR
BIQUAD	Bi-quadratic (type of filter function)
BSI	Battery Size Indicator
BT	Bluetooth
CBus	MCU controlled serial bus connected to UPP_WD2, UEME and Zocus
CCP	Compact Camera Port
CDMA	Code division multiple access
CDSP	Cellular DSP (expected to run at low levels)
CLDC	Connected limited device configuration
CMOS	Complimentary metal-oxide semiconductor circuit (low power consumption)
COF	Chip on Foil
COG	Chip on Glass
CPU	Central Processing Unit
CSD	Circuit-switched data
CSR	Cambridge silicon radio
CSTN	Colour Super Twisted Nematic
CTSI	Clock Timing Sleep and interrupt block of Tiku
CW	Continuous wave
D/A-converter	Digital-to-analogue converter
DAC	Digital-to-analogue converter
DBI	Digital Battery Interface
DBus	DSP controlled serial bus connected between UPP_WD2 and Helgo
DCT-4	Digital Core Technology

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DMA	Direct memory access
DP	Data Package
DPLL	Digital Phase Locked Loop
DSP	Digital Signal Processor
DTM	Dual Transfer Mode
DtoS	Differential to Single ended
EDGE	Enhanced data rates for global/GSM evolution
EGSM	Extended GSM
EM	Energy management
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
ESD	Electrostatic discharge
FCI	Functional cover interface
FPS	Flash Programming Tool
FR	Full rate
FSTN	Film compensated super twisted nematic
GMSK	Gaussian Minimum Shift Keying
GND	Ground, conductive mass
GPIB	General-purpose interface bus
GPRS	General Packet Radio Service
GSM	Group Special Mobile/Global System for Mobile communication
HSDPA	High-speed downlink packet access
HF	Hands free
HFCM	Handsfree Common
HS	Handset
HSCSD	High speed circuit switched data (data transmission connection faster than GSM)
HW	Hardware
I/O	Input/Output
IBAT	Battery current
IC	Integrated circuit
ICHAR	Charger current
IF	Interface
IHF	Integrated hands free
IMEI	International Mobile Equipment Identity
IR	Infrared
IrDA	Infrared Data Association

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ISA	Intelligent software architecture
JPEG/JPG	Joint Photographic Experts Group
LCD	Liquid Crystal Display
LDO	Low Drop Out
LED	Light-emitting diode
LPRF	Low Power Radio Frequency
MCU	Micro Controller Unit (microprocessor)
MCU	Multiport control unit
MIC, mic	Microphone
MIDP	Mobile Information Device Profile
MIN	Mobile identification number
MIPS	Million instructions per second
MMC	Multimedia card
MMS	Multimedia messaging service
MTP	Multipoint-to-point connection
NTC	Negative temperature coefficient, temperature sensitive resistor used as a temperature sensor
OMA	Object management architecture
OMAP	Operations, maintenance, and administration part
Opamp	Operational Amplifier
PA	Power amplifier
PDA	Pocket Data Application
PDA	Personal digital assistant
PDRAM	Program/Data RAM (on chip in Tiku)
Phoenix	Software tool of DCT4.x and BB5
PIM	Personal Information Management
PLL	Phase locked loop
PM	(Phone) Permanent memory
PUP	General Purpose IO (PIO), USARTS and Pulse Width Modulators
PURX	Power-up reset
PWB	Printed Wiring Board
PWM	Pulse width modulation
RC-filter	Resistance-Capacitance filter
RF	Radio Frequency
RF PopPort™	Reduced function PopPort™ interface
RFBUS	Serial control Bus For RF

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RSK	Right Soft Key
RS-MMC	Reduced size Multimedia Card
RSS	Web content Syndication Format
RSSI	Receiving signal strength indicator
RST	Reset Switch
RTC	Real Time Clock (provides date and time)
RX	Radio Receiver
SARAM	Single Access RAM
SAW filter	Surface Acoustic Wave filter
SDRAM	Synchronous Dynamic Random Access Memory
SID	Security ID
SIM	Subscriber Identity Module
SMPS	Switched Mode Power Supply
SNR	Signal-to-noise ratio
SPR	Standard Product requirements
SRAM	Static random access memory
STI	Serial Trace Interface
SW	Software
SWIM	Subscriber/Wallet Identification Module
TCP/IP	Transmission control protocol/Internet protocol
TCXO	Temperature controlled Oscillator
Tiku	Finnish for Chip, Successor of the UPP
TX	Radio Transmitter
UART	Universal asynchronous receiver/transmitter
UEME	Universal Energy Management chip (Enhanced version)
UEMEK	See UEME
UI	User Interface
UPnP	Universal Plug and Play
UPP	Universal Phone Processor
UPP_WD2	Communicator version of DCT4 system ASIC
USB	Universal Serial Bus
VBAT	Battery voltage
VCHAR	Charger voltage
VCO	Voltage controlled oscillator
VCTCXO	Voltage Controlled Temperature Compensated Crystal Oscillator
VCXO	Voltage Controlled Crystal Oscillator

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Vp-p	Peak-to-peak voltage
VSIM	SIM voltage
WAP	Wireless application protocol
WCDMA	Wideband code division multiple access
WD	Watchdog
WLAN	Wireless local area network
XHTML	Extensible hypertext markup language
Zocus	Current sensor (used to monitor the current flow to and from the battery)

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